THE ENGINEER

APRIL 24, 1959 | 28, ESSEX STREET, STRAND, LONDON, W.C.2 | TWO SHILLINGS

Pile Driving Plant for Malayan Railways

BSP

This plant is designed for pitching and driving 34" diameter hollow pre-stressed concrete piles 100 ft. long and weighing up to 18 tons. The frame has a height of 95 ft. and is arranged for power raking. It is equipped with an 8 ton single-acting steam hammer, two 6 ton double-drum winches and an oil-fired boiler.

A second plant, with a frame 130 ft. high, was supplied for driving similar piles up to 140 ft.

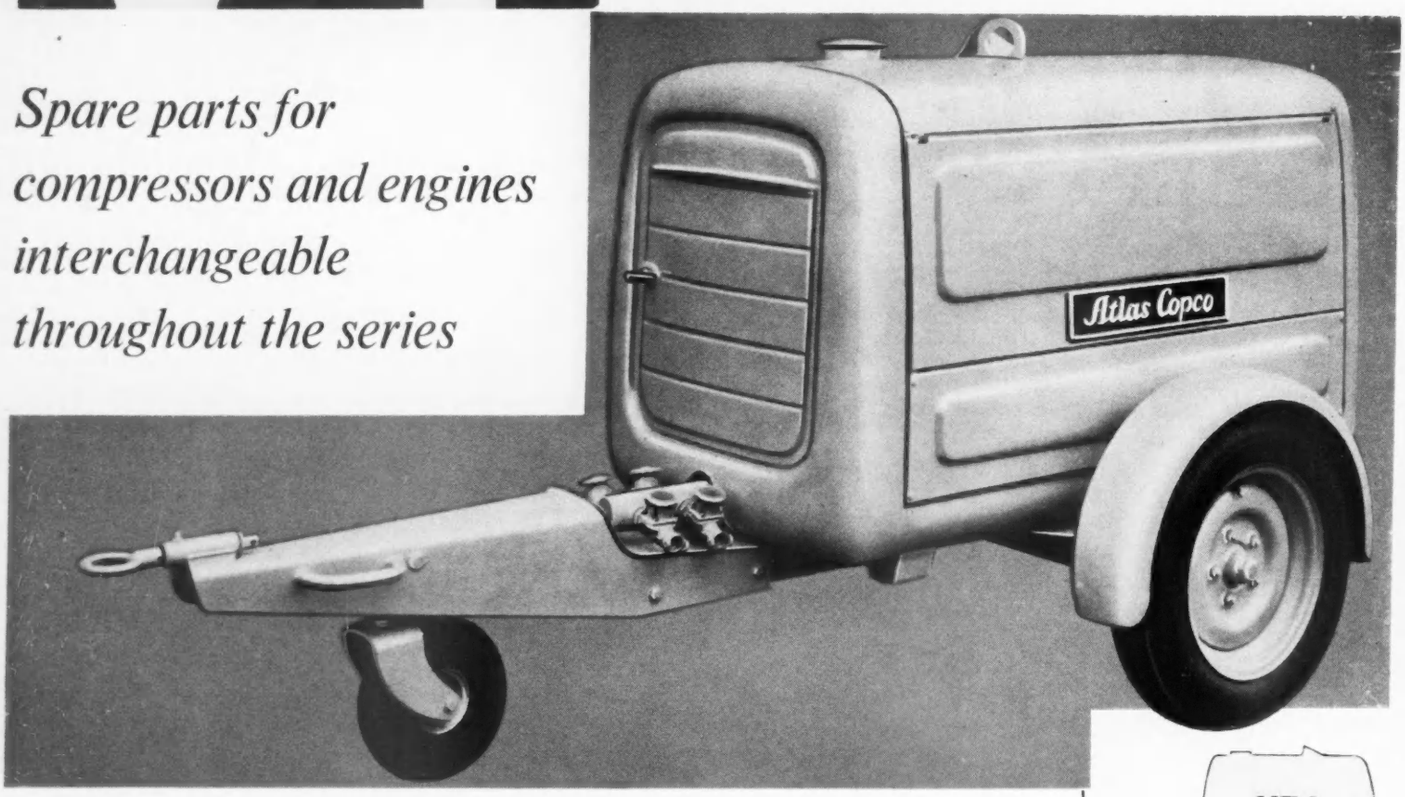
THE BRITISH STEEL PILING CO. LTD.
10 HAYMARKET · LONDON S.W.1.
Telephone TRAfalgar 1024/8

VT

'PACKAGED POWER'

the world's lightest and smallest series of portable compressors—piston or rotary!

Spare parts for compressors and engines interchangeable throughout the series

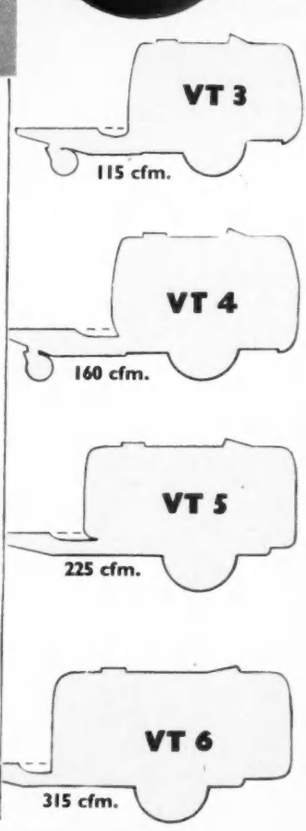


Atlas Copco now introduces a range of VT compressors, all incorporating the major changes in design and production that made the VT4 so successful. The VT series comprises four compressors with capacities from 115 to 315 cfm. These new machines have taken power/weight ratios into a new dimension, being lighter and more compact than any other type of compressor, piston or rotary, in their class.

- All machines are TURBO-COOLED—100% air-cooling—no risk of freezing or overheating and they work with equal efficiency anywhere in the world.
- The VT machines are the result of major changes in design and production methods. They are the only compressors with the crankcase, bellhousing and cylinder ducting in one piece welded design.
- Basic simplicity eliminates maintenance problems—local mechanics anywhere can service these units; the canopy is completely stripped in minutes; loosen three bolts and the complete engine-compressor unit lifts out; unscrew one nut and all four valves in the low pressure cylinder can be removed.
- The FUELMISER automatic speed adjuster means smooth running and fuel saving of up to 25%.
- Manhandling on site is a simple operation due to the low weight and pivoting nose wheel.

Torsion bar suspension and built-in lifting eye simplify transport problems.

- Powered by rugged Deutz 4-stroke air-cooled diesel engines, backed by a world-wide service organisation.
- Both compressors and engines use the same type of lubricant.
- Fully automatic drain cocks simplify daily operation.



Atlas Copco PUTS COMPRESSED AIR TO WORK FOR THE WORLD

Contact your local Atlas Copco company or agent or write to: Atlas Copco AB, Stockholm 1, Sweden

P27

THE ENGINEER

Established 1856

No. 5387 APRIL 24, 1959 VOL. 207

EDITORIAL CONTENTS

Leading Articles

One Point of View . . . 637
Biomechanics . . . 637
Processing Coal . . . 638
Novel British Motor-Car . . . 638
Intuitive Ergonomics . . . 639
Timing Museum Acquisitions . . . 639

Articles

100 Years Ago . . . 639
Engineering, Marine, Welding and Nuclear Energy Exhibition. No. III . . . 640
Resignalling at Newcastle. No. II . . . 643
W. B. Lewis Canadian Atomic Energy Development . . . 646
The Aircraft Industry . . . 649
Iron and Steel Engineers in the Netherlands . . . 651
Technical Education . . . 651
Front-Engine, Rear-Drive Light Car . . . 654
H. T. Jessop The Work of Coker and Filon in Photoelasticity . . . 656
British Railways 50 c/s Electrification. No. II . . . 658
Institution of Naval Architects' Annual Spring Meeting. No. IV . . . 661
Large Locomotive Traverser . . . 662
Duston Mill Pumping Station . . . 663
National Engineering Laboratory . . . 664
Detergents and River Pollution . . . 664
Driverless Guided Industrial Truck System . . . 664
Driver-Guard Communication in Trains . . . 664
Award of the James Alfred Ewing Medal . . . 664
Maidenhead By-pass Motorway . . . 665
Brushless Marine Alternator . . . 665
Vibrating-Cylinder Transducer . . . 665
Steel Works Training Centre . . . 666
200MW Turbo-Alternator for High Marnham . . . 666

Continental Section

Soviet Chemical Congress . . . 668
Self-Righting Lifeboat . . . 668
Level Adjustment Valve . . . 668
Bordeaux Refinery . . . 668

American Section

Double Cantilever Bridge over the Carquinez Strait in California. No. II . . . 669
Turntable Rig for Flame-Cutting . . . 671

LETTERS

Fairlie Locomotives . . . 652
Overlapping of British Standards . . . 652

BOOK REVIEWS . . . 652

OBITUARY

A. P. Chalkley, B.Sc. . . . 653
I. V. Robinson . . . 653

NEWS AND NOTES

Industrial and Labour Notes . . . 667
Personal and Business . . . 672
British Patent Specifications . . . 673
Launches and Trial Trips . . . 674
Forthcoming Engagements . . . 674
Advanced Engineering Courses . . . 674

INDEX TO ADVERTISERS : PAGE 129 **CLASSIFIED ADVERTISEMENTS : PAGE 119**

NOTICE TO READERS No undertaking can be given to return illustrations or manuscripts. Correspondents are requested to keep copies. No notice is taken of anonymous communications.

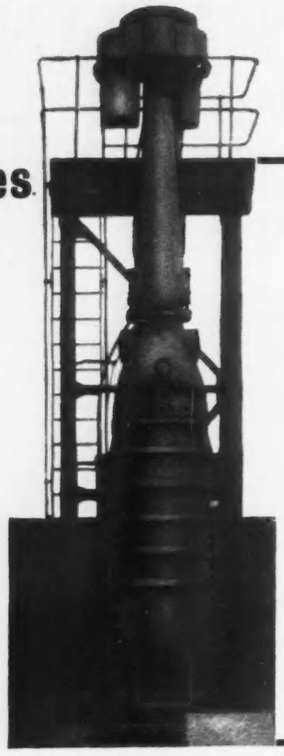
SUBSCRIPTIONS U.K. and ABROAD £5 10. 0. p.a., including postage (CANADA £5 5. 0.). Single copies 2s. each, plus 9d. postage. Also on sale at newsagents.

'THE ENGINEER' BUYERS GUIDE Published annually. One FREE copy is sent to all direct postal subscribers on publication and delivered by newsagents to all regular readers. Additional copies are obtainable at 7s. 6d. each. Postage 1s. 9d. extra.

Published every Friday by

MORGAN BROTHERS (PUBLISHERS) LTD., at 28, ESSEX STREET, STRAND, LONDON, W.C.2. Telephone : CENtral 6565

Northampton
relies on Bailey's valves



At the Northampton Power Station, Bailey valves control the water supply for the cooling system. Backed by more than a century's experience the company provides a standard range of high quality valves from 2 to 54 inch bore for pressures up to 150 p.s.i., for the control of oil, water, steam or gas. Advice is gladly given on all kinds of applications and a special Contracts Department is maintained to deal with valve schedules on large contracts anywhere in the world.

A FEW OF THE INSTALLATIONS USING BAILEY'S VALVES

Malacca Power Station — Selkirk (Manitoba) Power Station
Basra Power Station — Barbados Power Station
Baghdad Refinery — Barri Sudan
Mond Nickel Refinery — Colenso Power Station
Penang Power Station — Kuwait Refinery
Roxburgh Power Station

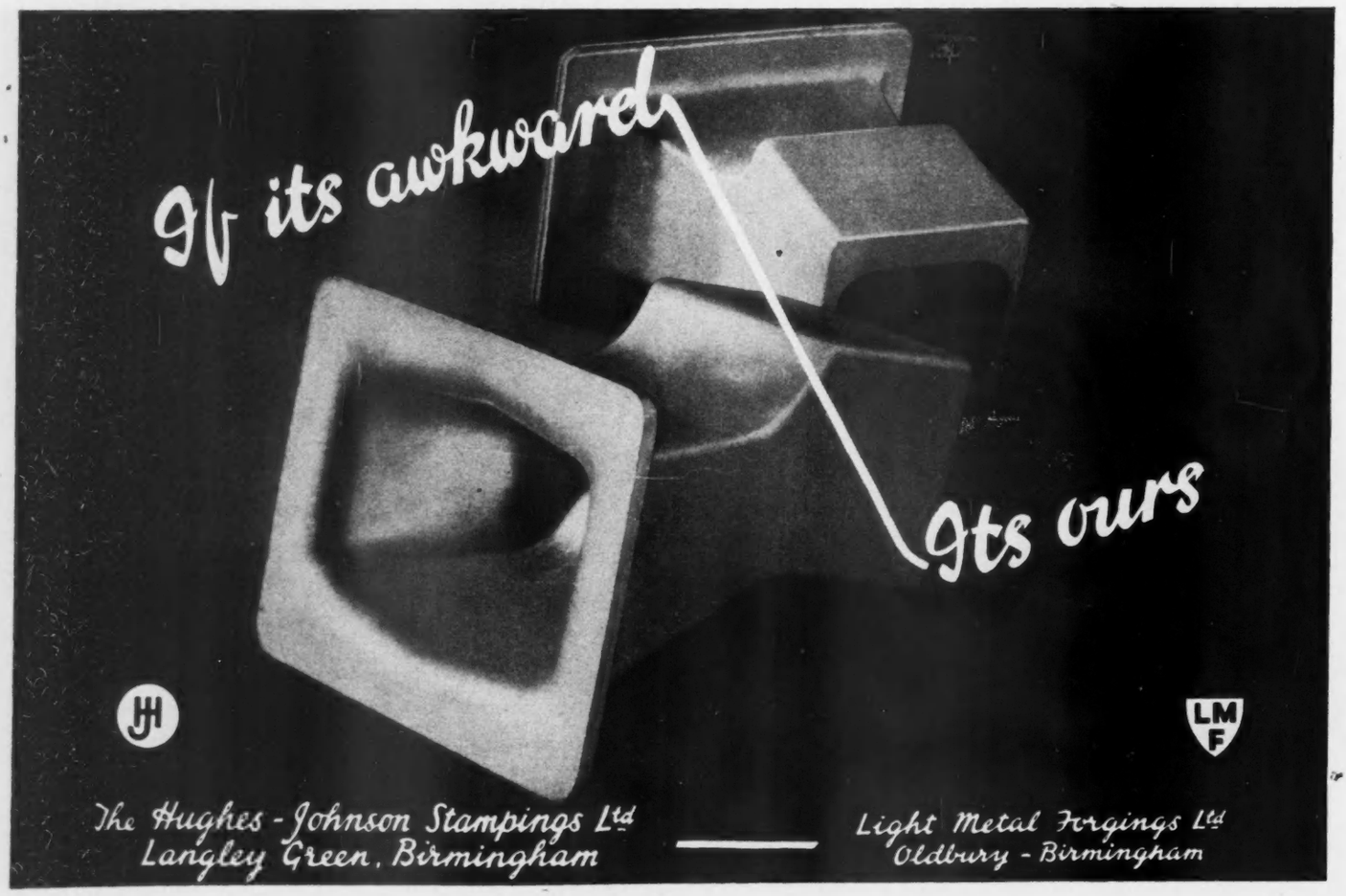
MOST OF THE C.E.G.B. POWER STATIONS AND A.E.A. STATIONS INCLUDING

Battersea	Hams Hall	Nottingham
Bold	High Marnham	Staythorpe
Bradwell	Littlebrook	Stella North
Calder Hall	Marchwood	Stella South
Chapelcross	Northampton	Willington

Bailey's VALVES

SIR W. H. BAILEY & CO. LTD. HEAD OFFICE & WORKS: PATRICROFT, MANCHESTER
TELEPHONE: *Eccles* 3487-8-9 GRAMS: *Beacon, Telex, Eccles.* LONDON OFFICE: Selinas Lane, Dagenham, Essex. *DOMinion* 2277-8-9
SLUICE VALVES · PRESSURE REGULATORS · TEST PUMPS · TURNSTILES

TGA BA11



15 contracts from S.P.D. Ltd

THE WAREHOUSING AND DISTRIBUTING ASSOCIATE OF UNILEVER LTD.

endorse the supremacy of

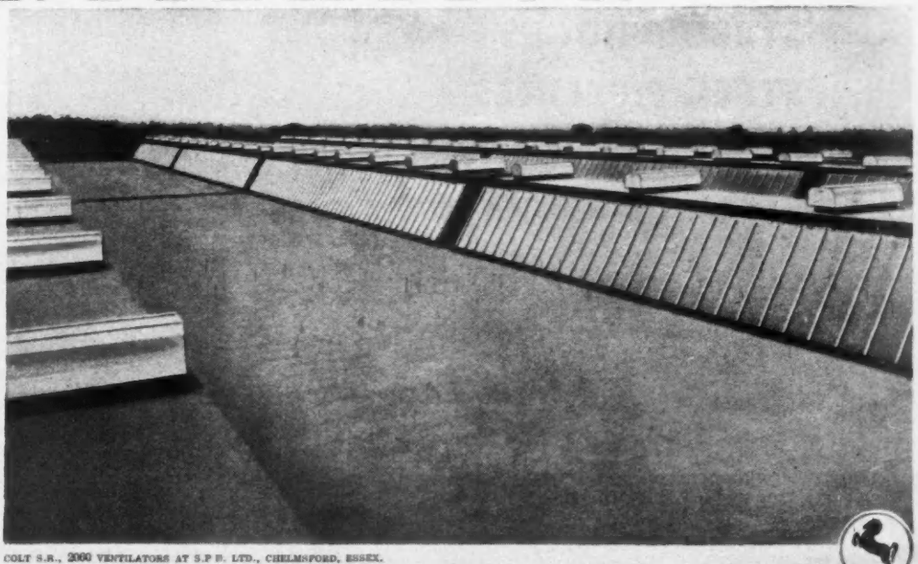
COLT

VENTILATION

Time and again, industrialists large and small place repeat orders with Colt. And for three good reasons. Colt ventilation systems depend in the main on internal convection currents—*not* external forces—and are therefore little affected by the vagaries of the wind, Colt offer an unparalleled range of ventilators. And most important, every Colt recommendation is based on a thorough analysis of the building, plant and process either from a site survey or drawings. Such thoroughness influences firms such as S.P.D. Ltd. It will impress you, too. Ask your secretary to send for a free manual to Dept. **S15/4B**

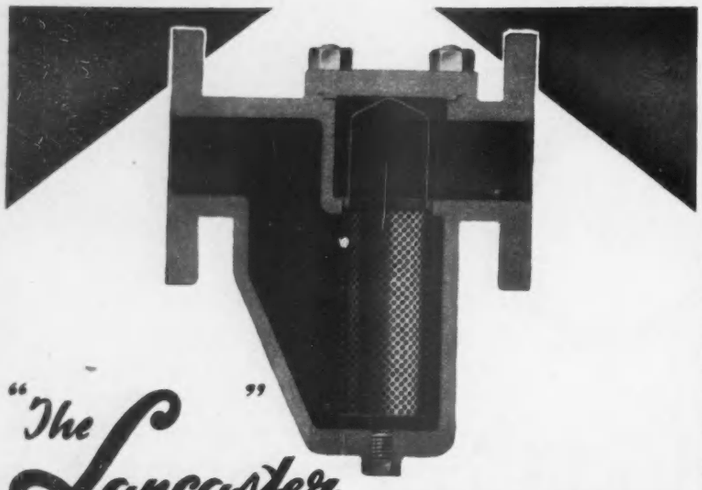
Among the 12,000 major Industrial Organisations using Colt equipment are:

16 contracts: *General Motors Ltd.*
15 contracts: *Cow & Gate Ltd.*
25 contracts: *British Oxygen Co. Ltd.*
14 contracts: *Bristol Aircraft Co. Ltd.*
19 contracts: *Philips Electrical Industries Ltd.*
11 contracts: *Thomas Hedley & Co. Ltd.*
9 contracts: *Joseph Lucas Ltd.*
10 contracts: *Vandervell Products Ltd.*
20 contracts: *Courtaulds Ltd.*



COLT S.R., 2000 VENTILATORS AT S.P.D. LTD., CHELMSFORD, ESSEX.

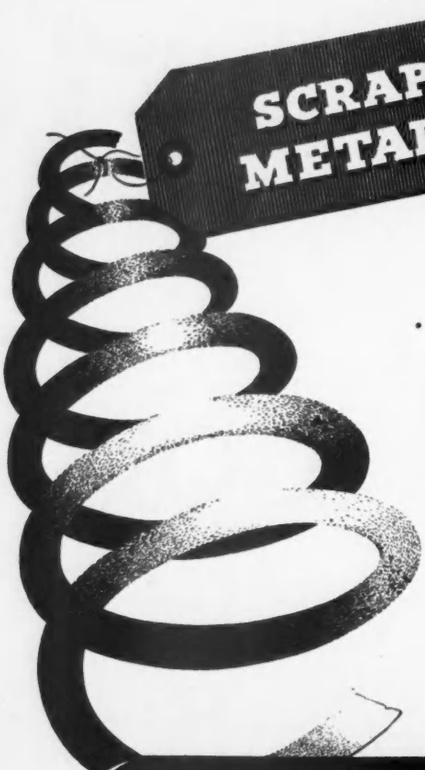
COLT VENTILATION LIMITED · SURBITON · SURREY · TELEPHONE: ELMBRIDGE 0161 (10 LINES)



"The Lancaster" STRAINERS

Made in sizes ½" to 4" in Cast Iron, Cast Steel or Gun Metal. Illustration shows "The Lancaster" T Strainer, with element removable from top.
Perforated Copper element, but Stainless Steel can be supplied if required.
We also manufacture—Steam Traps for all purposes, Separators, Exhaust Heads, Metallic Packings, Pistons Rings, etc.

LANCASTER & TONGE LTD
PENDLETON · MANCHESTER · ENGLAND
Telephone: Pendleton 1484/5/6
Telegrams: "Pistons, Manchester"



. . . then the name that SPRINGS to mind is . . .

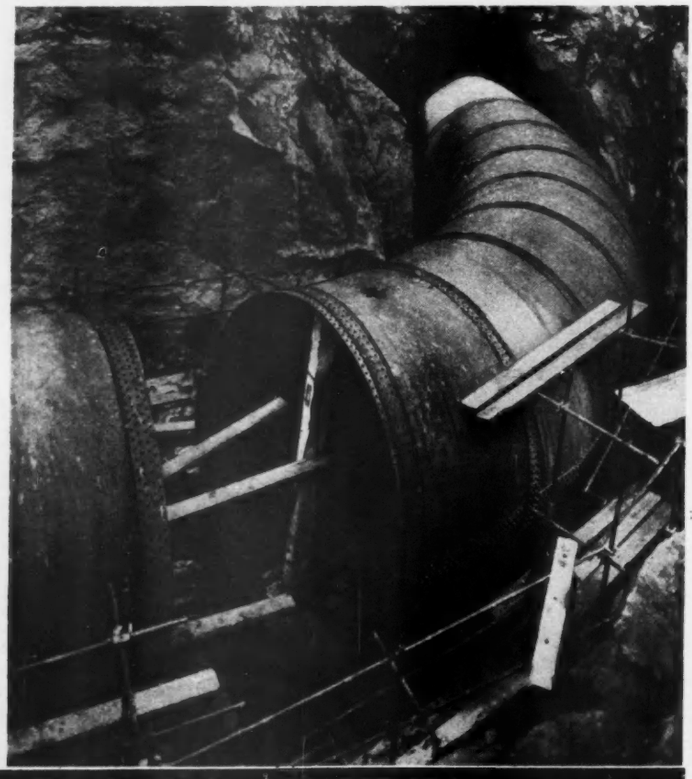
M. LYNCH & SON LTD
MILL WHARF, CANAL ROAD, STROOD, KENT
TEL. STROOD 7545-6 GRAMS. LYNCH, STROOD

MERCHANTS & SUPPLIERS • STOCKHOLDERS OF STRUCTURAL STEEL

Structural Steel Work
of all descriptions

STEEL BRIDGES
STEEL PIPELINES
STEEL STRUCTURES
STEEL RAILWAY WAGONS

Shipbreakers and Dismantlers
Iron and Steel Stockholders
Non-ferrous Metal Merchants
Machine Tool Specialists



P. & W. MACLELLAN, LTD. Established 1811

Offices and Warehouses: 129 TRONGATE, GLASGOW, C.1 Telephone: BELL 3404 (20 LINES) Works: CLUTHA WORKS, GLASGOW, S.1 Telephone: IBROX 1135
LONDON: CLUTHA HOUSE, 10 STOREY'S GATE, WESTMINSTER, S.W.1

FILTERS *by* PLENTY

THE FIRST SCIENTIFIC APPROACH
TO PLANT PROTECTION
BY SIMPLE FILTRATION

No tools required.
No leakage.
No stagnation.

Will handle
the most viscous
liquids.
Bodies of cast iron,
cast steel,
stainless steel
or gun metal.
Steam jacketed
bodies available.
Made in any
size to do any job.

Folder on request.

Available in sizes
from ½ inch
to 36 inches

PLENTY
& SON Ltd.

EAGLE IRON WORKS,
NEWBURY, BERKS, ENGLAND

Telephone : Newbury 2363 (4 lines)
Telegrams : Plenty, Newbury

E.N.

Strictly to Specification

The selection of alloy for a given casting is influenced by design and foundry technique as well as by the physical properties required of the casting in service. Close co-operation between designer and founder is therefore desirable to determine the most suitable alloys and this must be effectively supported by regular checks of incoming materials and foundry melts to ensure conformity to specification.

William Mills Limited

FOUNDERS IN ALUMINIUM ALLOYS

Aluminium gravity die casting used by Ransomes Sims & Jefferies Ltd. in their MG.5 tractor.

SAND CASTINGS GRAVITY DIE CASTINGS PRESSURE DIE CASTINGS | FRIAR PARK FOUNDRY, FRIAR PARK ROAD, WEDNESBURY, STAFFS.

AP118

FOR CONTROLLED INDUSTRIAL HEATING. . . .

THERMOLIER
unit heaters

* PROVIDE HEAT EXACTLY WHERE REQUIRED
* OCCUPY NO FLOOR SPACE
* ARE EASY TO INSTALL
* COMBINE LOW RUNNING COSTS WITH HIGH EFFICIENCY

Thermolier unit heaters are suitable for use with steam or accelerated hot water. Output capacity tables and all further particulars are available from:—

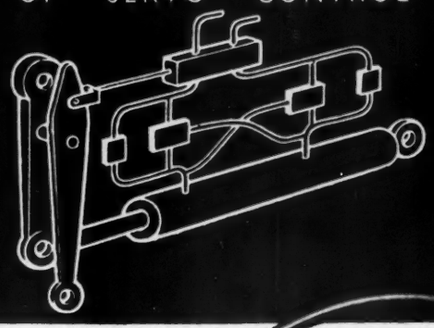
Mather & Platt LIMITED

PARK WORKS · MANCHESTER 10

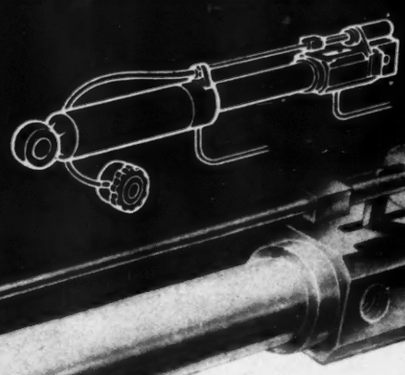
Telephone: COLlyhurst 2321 *Telegrams: Sprinkler, Manchester*

954

THE PRESENT COMPLICATED SYSTEM OF SERVO CONTROL



THE NEW SIMPLIFIED COAXIAL SYSTEM



NEW!

HYDRAULIC OR PNEUMATIC ACTUATOR

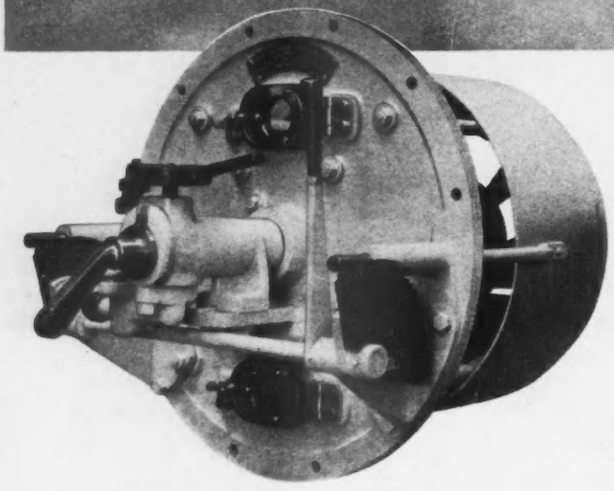
FOR THE FIRST TIME— A LINEAR ACTUATOR WITH EXACT POSITIONAL CONTROL OF PISTON ROD EXTENSION

- Servo or No Servo.
- Electric or Mechanical Input Signals.
- No-Leak Valve Allows Accumulator Operation or Small Capacity Pump.
- Automatic Lock Valves Incorporated.
- Instantaneous Response to Controls.
- Insensitive to Temperature Variations.
- Accurate to any Required Degree. Simple, Low Cost.

HP

HYDRAULICS & PNEUMATICS LTD. WULFRUNA WORKS, VILLIERS STREET, WOLVERHAMPTON. Telephone: Wolverhampton 24456.

To help keep the air of Britain clean

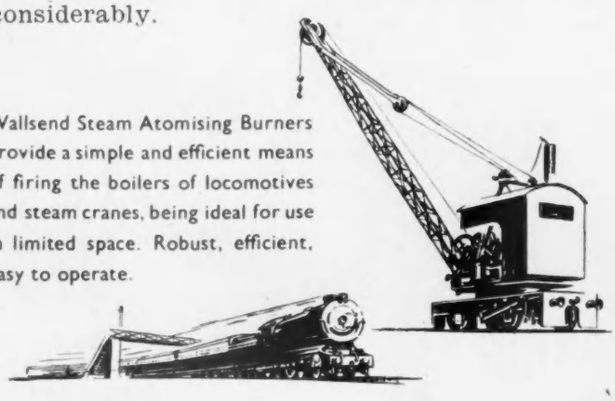


Consult the specialists in manufacture and installation of every size and type of Liquid Fuel Burner.

THE WALLSEND SLIPWAY AND ENGINEERING COMPANY LIMITED

Wallsend Oil Burning Systems are making a valuable contribution to the Clean Air Act. They have already been installed successfully in many industrial plants. They eliminate heavy smoke and grit and, in addition, their excellent design and high efficiency helps to reduce running costs considerably.

Wallsend Steam Atomising Burners provide a simple and efficient means of firing the boilers of locomotives and steam cranes, being ideal for use in limited space. Robust, efficient, easy to operate.



WALLSEND-ON-TYNE, *PHONE : WALLSEND 63161, GRAMS : WALL, WALLSEND*

ENGINEERING SERVICES
The works division of the company specialises in welded fabrications and all types of pressure vessels, to all codes including Lloyds Class I, for the chemical, gas, petroleum, nuclear energy and iron making industries.
Limitation as to size and weight is governed only by transport arrangements, but full facilities for site erection can be provided.
Stainless steel absorption tower 131'0" long and 15'0" diameter, weighing 93 tons.
Edwin Smaker
ABP
ASHMORE, BENSON, PEASE & COMPANY
ASSOCIATED WITH THE POWER-GAS CORPORATION LIMITED
STOCKTON-ON-TEES AND LONDON
376 AUSTRALIA · CANADA · INDIA · FRANCE · SOUTH AFRICA

Welding the underside of a transformer tank.

Welded by

JENKINS

OF ROTHERHAM

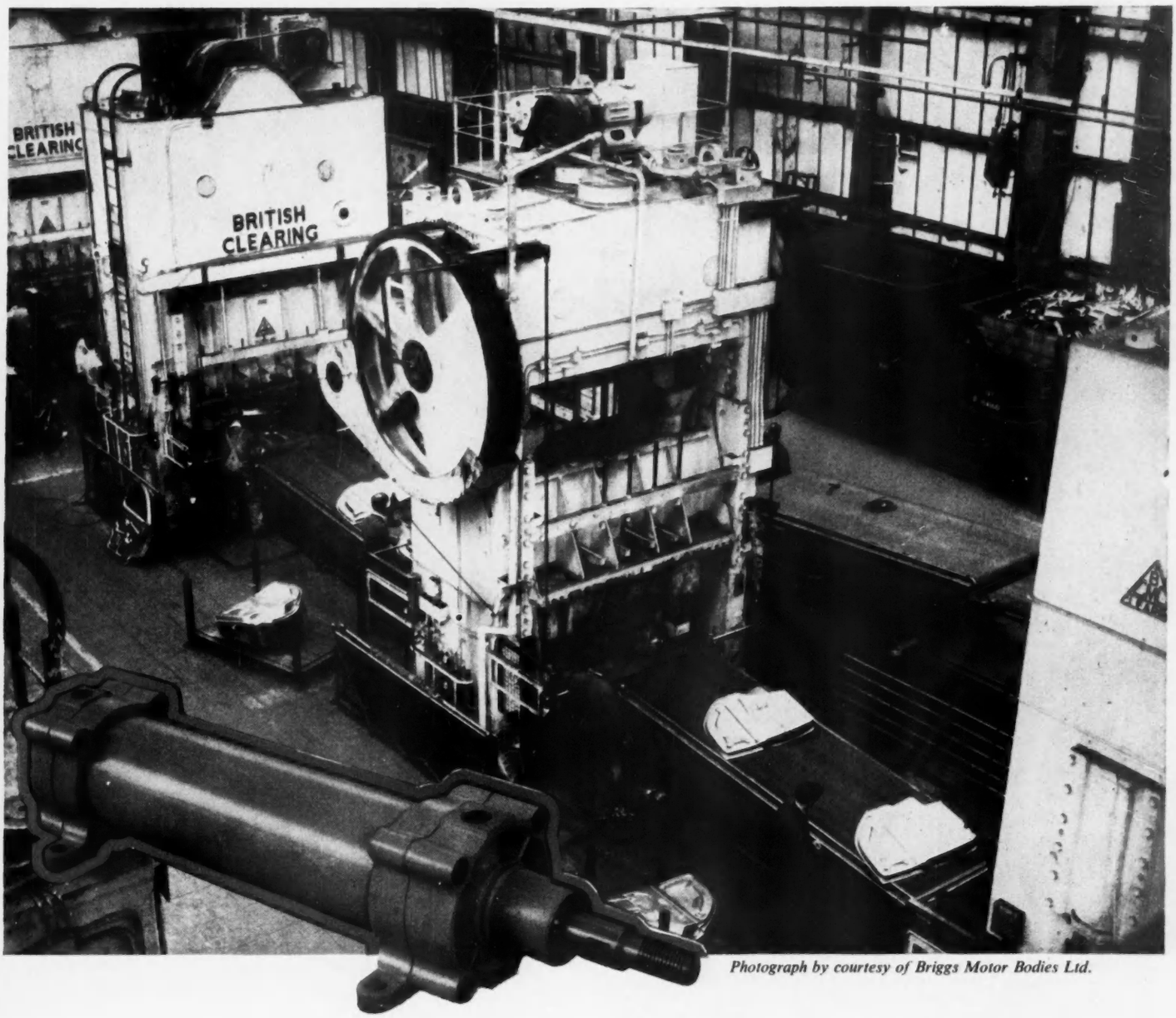
Jenkins fabricate fractionating columns, heavy pressure vessels and similar large plant up to 60 tons. Boring capacity to the following limits is also available :

Boring spindle	7"
Longitudinal traverse	50'0"
Transverse "	15'0"
Vertical "	8'0"
Maximum facing diameter	8'0"

Welded fabrications to the requirements of Lloyds Class 1 (fusion-welded pressure vessels) A.S.M.E., A.O.T.C. codes and similar specifications.

ROBERT JENKINS & CO. LIMITED · ROTHERHAM

Telephone: 4201-6 (6 lines)



Photograph by courtesy of Briggs Motor Bodies Ltd.

'Fescol'-ised Air Cylinders help to keep Production Moving

The air cylinders supplied by Baldwin Instrument Co. Ltd., to provide power operation for automatic work handling devices, have 'Fescol'-ised bores and piston rods to reduce friction and ensure maximum life from seals. This is one further example of the way in which Fescol, who pioneered the electro-deposition of nickel and chrome for engineering purposes, still lead the way, adapting their process to help each new industrial development.

If you would like to know more about the process, and its use in preventing corrosion and protecting new machinery please send for publication No. E.6

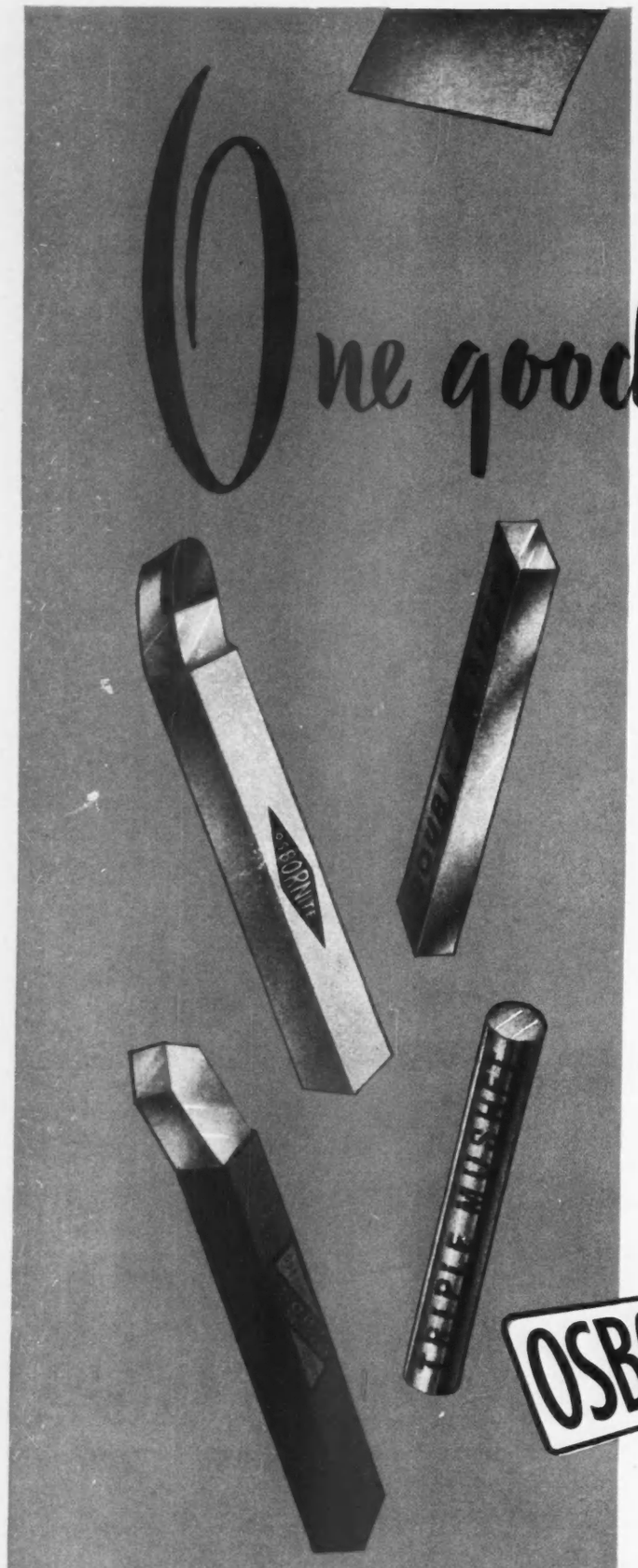
FESCOL

Established 1920

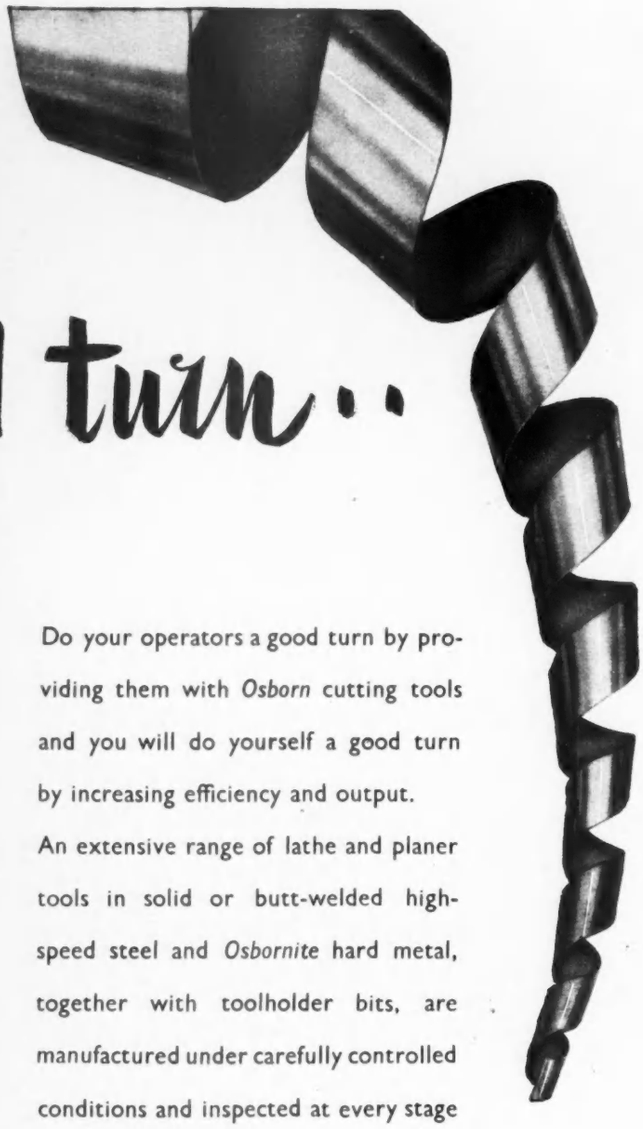
FESCOL LIMITED · NORTH ROAD · LONDON N7

BRANCH WORKS AT PORT GLASGOW, HUDDERSFIELD AND BROWNHILLS

Sole Licensees for Australasia: De Havilland Aircraft Pty. Ltd., Milperra Road, Bankstown, N.S.W.



One good turn . .



Do your operators a good turn by providing them with *Osborn* cutting tools and you will do yourself a good turn by increasing efficiency and output.

An extensive range of lathe and planer tools in solid or butt-welded high-speed steel and *Osbornite* hard metal, together with toolholder bits, are manufactured under carefully controlled conditions and inspected at every stage to ensure maximum quality.

Comprehensive stocks constantly maintained

If you are using the new

"MUSHET SPECIAL" **'VG'** HIGH-SPEED STEEL

you will know how good it is—if not please ask for details.

Available as:

lathe and planer tools, toolholder bits, bars and blanks.

SAMUEL OSBORN & CO., LIMITED.

CLYDE STEEL WORKS, SHEFFIELD.

Fine Steelmakers • Steelfounders • Engineers' Toolmakers

TRADE MARK

HIGGS MOTORS LTD.

CHAIRMAN WALTER F. HIGGS M.I.E.E.

BIRMINGHAM 6 ENGLAND

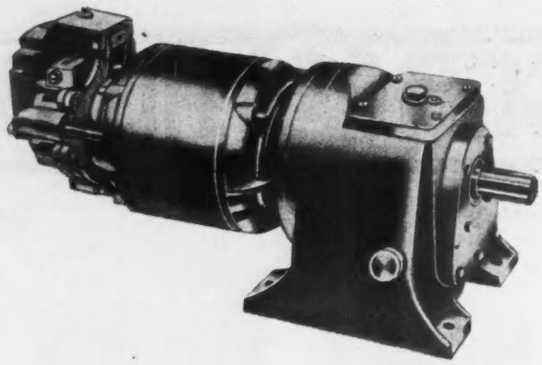
DRIP-PROOF MOTORS

TO BRITISH STANDARD DIMENSIONS
CLASS E INSULATION
DELIVERY EX STOCK
COMPETITIVE PRICES

OTHER MOTORS UP TO 1,000 H.P.
AT SHORT DELIVERIES.

AGENTS AND BRANCHES COVER THE WORLD

C



FRACTIONAL TO 150 H.P.
Standard and Flameproof.

GEARED MOTORS WITH ELECTRO-MAGNETIC BRAKES

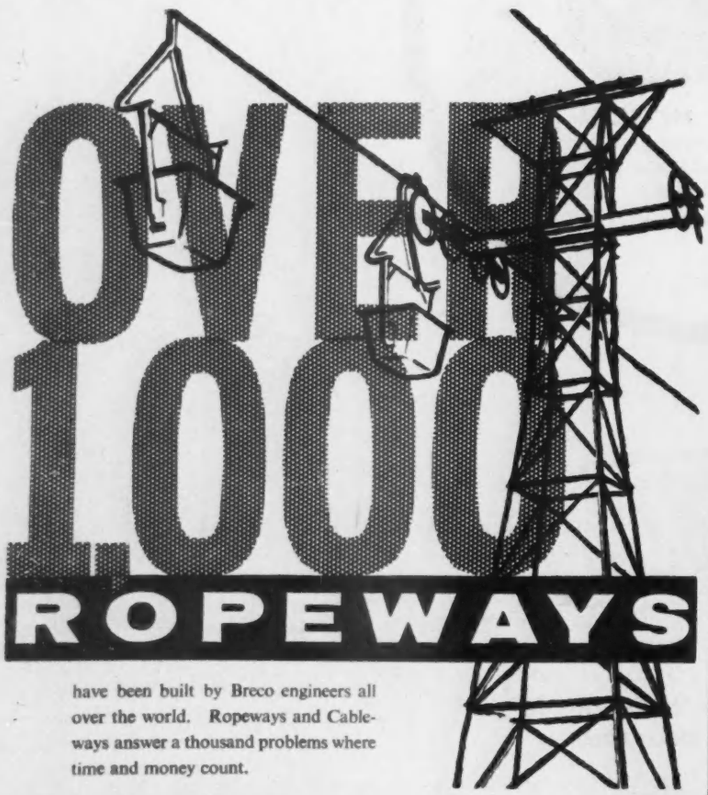
GEARED MOTORS.
SPEED REDUCERS.
SPEED INCREASE G/BOXES.

WORM GEARED MOTORS.
CONTRA-ROTATING G/BOXES.
VARIABLE SPEED UNITS.

FLANGE MOUNTING GEARED MOTORS.
SLO-REV GEARED MOTORS.
1/10 to 300 h.p.

Electropower Gears Ltd

KINGSBURY WORKS, KINGSBURY ROAD, LONDON, N.W.9. PHONE: COLINDALE 4621-3 GRAMS: LEKTROPOWA, HYDE, LONDON



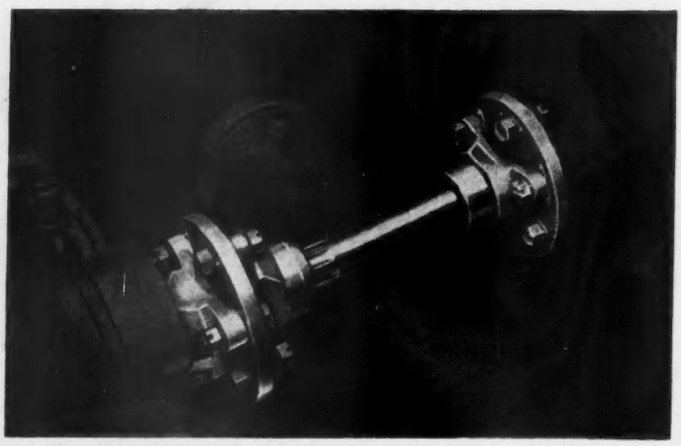
OVER 1,000 ROPEWAYS

have been built by Breco engineers all over the world. Ropeways and Cableways answer a thousand problems where time and money count.

BRECO the Big name behind the Big ropeways
ROPEWAYS CABLEWAYS
British Ropeway Engineering Co. Ltd., Plantation House, Mincing Lane, London, E.C.3. 'Phone MINcing Lane 7901.
Telegraphic Address: Boxhauling, Fen, London.

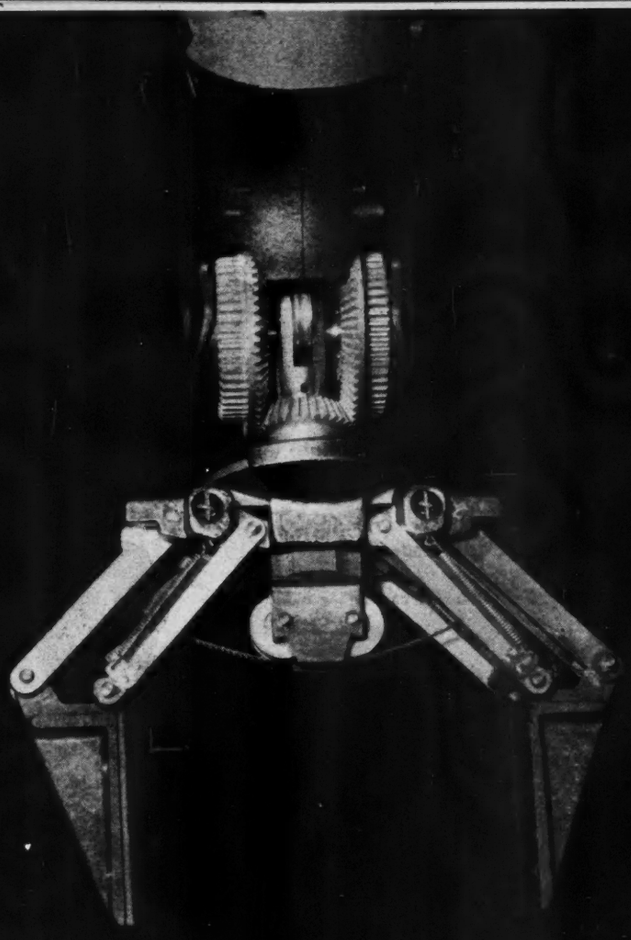
G member of the Glover Group

POWER TRANSMISSION—
through the medium of
FLEXIBLE FABRIC COUPLING DISCS



★ Are easily assembled.
★ Give extreme torsional flexibility.
★ Absorb irregularities in load variations.
★ Axial and parallel misalignments are corrected.

ESTABLISHED 1895
HERMETIC RUBBER Co LTD
Hermetic Works, Ryland Street, BIRMINGHAM, 16
'Phone: EDGbaston 0983/4 Telegrams: "Hermetic Birmingham."



Manipulators

The manipulators used in atomic establishments have to operate under exacting conditions. They are constructed of stainless steel and Kanigen plated aluminium and the plate serves two functions. It resists corrosion, and because of the smoothness of the finish it also assists in decontamination of the component parts from radio-active material and the combination of stainless steel and Kanigen plated aluminium reduces the electro potential difference between the component parts. These manipulators, manufactured by Savage & Parsons Ltd., are supplied to users all over the world.

Visit Stand No. 3 Outer Row Gallery Grand Hall Engineering, Marine, Welding and Nuclear Energy Exhibition at Olympia · April 16-30th

Kanigen

A HARD & CORROSION RESISTANT PLATE

Kanigen is used on the aluminium parts of the Tong End assembly and the Master Hand assembly.

KANIGEN is a nickel-phosphorus plate deposited by chemical reduction: thickness can be controlled to fine limits and is of complete and uniform coverage.

PROPERTIES:

Composition	92% Nickel 8% Phosphorus
Melting Point	880°C.
Electrical resistivity	60 microohm cm.
Hardness	500-1,000 V.P.N. according to heat treatment
Coverage	Extremely uniform

Kanigen can be applied to all ferrous metals, aluminium, copper and brass. The plating plant at Oldbury has now been extended, two extra plating tanks are in operation and enquiries for jobbing plating are welcomed. Full information is available on request.

Albright & Wilson
(MFG) LTD
Kanigen Department
1 KNIGHTSBRIDGE GREEN · LONDON SW1

Kanigen is a regd. trade mark of Albright & Wilson Ltd

KANIGEN

TSW 691

KONTITE

The World's Finest Pipe Fittings

- All Kontite Castings are made in corrosion resisting gunmetal.
- The Kontite range of fittings is the largest in the trade.
- Our delivery service is second to none and all items can be delivered within a matter of days.
- Kontite Compression Fittings are made for all sizes of pipe up to 6" bore.

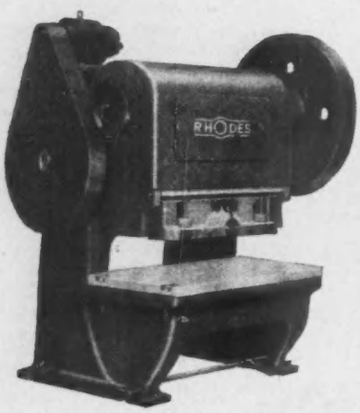
Free comprehensive catalogue will be supplied on request.

KAY & COMPANY (Engineers) LTD.
ENGINEERS BRASSFOUNDERS & ALLOYERS
Bolton Brass Works, Blackhorse Street, Bolton, Lancs.
Phone: 3041 Grams: "Kontite" Bolton Telex No. 63-186

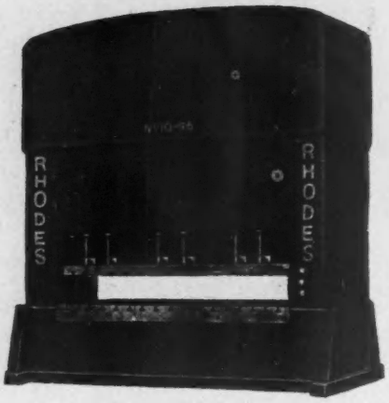
HOWEVER SPECIAL YOUR REQUIREMENTS MAY BE ——— WE CAN SUPPLY FITTINGS FOR YOUR PURPOSE

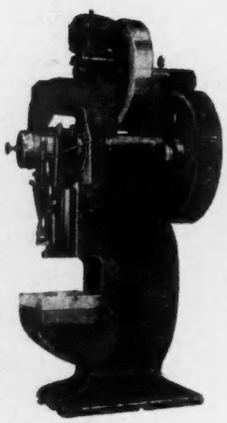
JOSEPH **RHODES** & SONS Ltd
Of WAKEFIELD ENG. Estab. 1824

THE SPECIALISTS IN PRESS CONSTRUCTION



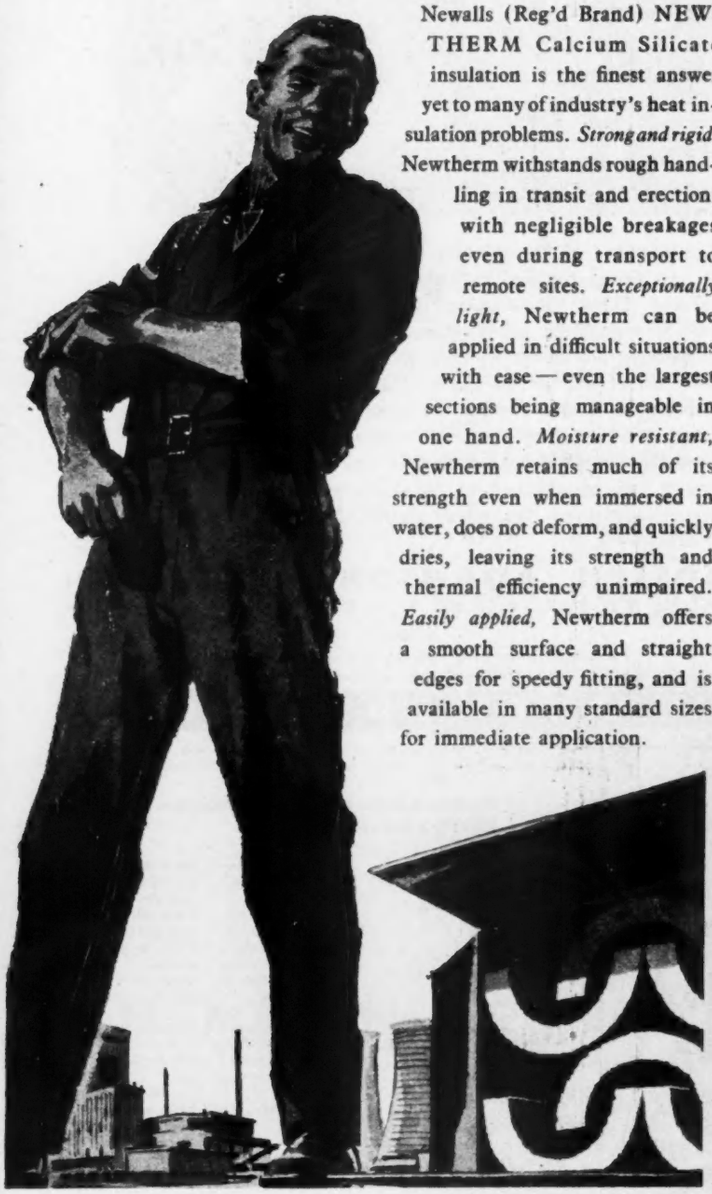
SOUND · SOLID · ACCURATE · RELIABLE.





NO OTHER PRESSES CAN COMPETE WITH THEM

give NEWTHERM your toughest insulation assignment



Newalls (Reg'd Brand) NEWTHERM Calcium Silicate insulation is the finest answer yet to many of industry's heat insulation problems. *Strong and rigid,* Newtherm withstands rough handling in transit and erection, with negligible breakages even during transport to remote sites. *Exceptionally light,* Newtherm can be applied in difficult situations with ease — even the largest sections being manageable in one hand. *Moisture resistant,* Newtherm retains much of its strength even when immersed in water, does not deform, and quickly dries, leaving its strength and thermal efficiency unimpaired. *Easily applied,* Newtherm offers a smooth surface and straight edges for speedy fitting, and is available in many standard sizes for immediate application.

NEWTHERM Calcium Silicate is manufactured solely by

NEWALLS INSULATION COMPANY LIMITED

Head Office : **WASHINGTON, CO. DURHAM, ENGLAND**

A member of the TURNER & NEWALL ORGANISATION

Offices and Depots at :

LONDON, GLASGOW, MANCHESTER, NEWCASTLE UPON TYNE, BIRMINGHAM, BELFAST, DUBLIN, BRISTOL and CARDIFF. *Agents and Vendors in most markets abroad.*

HOLLAND / SLM ROTARY COMPRESSORS AND VACUUM PUMPS

GIVE SERVICE FOR TO-DAY, FOR TO-MORROW AND FOR YEARS AHEAD

Part of the English Electric Aircraft Equipment Laboratories with three HOLLAND/SLM 2-stage rotary vacuum pumps exhausting the altitude test chamber.

VISIT STAND B5 Ground Floor, Grand Hall, Olympia 16th—30th April.

The B. A. Holland Engineering Co. Ltd.

LINDO LODGE, STANLEY AVENUE, CHESHAM, BUCKS.

Telephone : 8406/8. Works : SLOUGH, BUCKS. Telegrams : Picturable, Chesham.

FABRICATIONS IN STEEL

INDUSTRIAL TANKS, ROOF & UNDERFRAME TANKS FOR RAILWAY COACHES, DIESEL ENGINE TANKS, PRESSED STEEL GUTTERS, LIGHT CONSTRUCTIONAL STEELWORK

SPECIALISTS IN* HOT DIP *GALVANIZING

JOSEPH ASH & SON LTD.

ESTABLISHED 1845

REA STREET SOUTH, BIRMINGHAM 5. ***Tel: MIDland 2441***

LONDON OFFICE : 225 WESTMINSTER ROAD, LONDON, S.E.1. ***Tel : WATerloo 4682***

LOCOMOTIVES

Designers and Builders of Steam, Diesel and Diesel-electric and Battery Locomotives for all purposes. Flame Proof Diesel and Battery Locos for underground working.

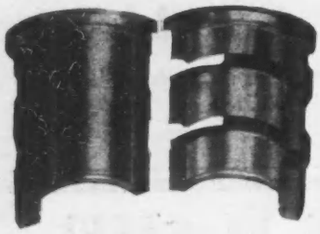
HUDSWELL, CLARKE & COMPANY LIMITED

Railway Foundry, Leeds

LONDON OFFICE:
14, Howick Place, Victoria Street, S.W.1

TELEPHONE:
Victoria 6786

WHITE METAL BEARING RECONDITIONING



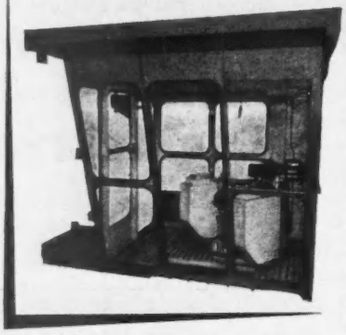
Enquiries please to:

Wheatley & Whiteley

99, Kirkstall Rd., Leeds, 3 Tel. 31122

JOSEPH ADAMSON

ELECTRIC OVERHEAD TRAVELLING CRANES



★ *a view of the cab showing the seat control unit.*

The Adamson 50/10 ton crane is the third of a series of new design supplied to Richard Thomas & Baldwins Limited, Ebbw Vale Section. Features of the crane include monolithic construction of the crab and the elimination of castings by mild steel fabrication of the hoist barrel and bottom block. The cab is of particular interest as it incorporates the most modern type of seat unit ensuring maximum vision and ease of control. Joseph Adamson electric overhead travelling cranes can be supplied to all specifications including cranes suited to the most exacting 24 hours-a-day process work.

JAC

JOSEPH ADAMSON & CO. LTD.

P.O. BOX 4 HYDE CHESHIRE

in association with

Adamson Alliance Co. Ltd., 165 Fenchurch St., London, E.C.3
Horsehay Co. Ltd., Wellington, Salop.

THE ADAMSON GROUP

1A. 25

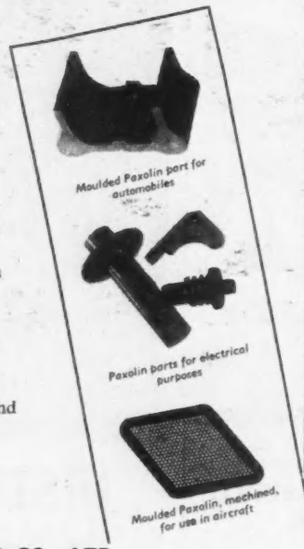
*In one form or another you constantly come across PAXOLIN**

"PAXOLIN" multi-purpose synthetic-resin bonded laminates combine excellent electrical insulating properties with high mechanical strength—they are ideal for many applications in both the electrical and general engineering industries.

"PAXOLIN" is manufactured in a wide range of grades suitable for punching, moulding and machining. It is tough and durable, light in weight, resistant to heat, cold, oil, moisture, corrosion and tropical conditions . . . a versatile material which can be supplied in the form of sheets, tubes and cylinders or as fabricated parts and components.

"PAXOLIN" has many important advantages; it will pay you to investigate them.

Put your problems to us. We have unique facilities.


Moulded Paxolin part for automobiles
Paxolin parts for electrical purposes
Moulded Paxolin, machined, for use in aircraft

Countless articles are made from Paxolin — here are a few examples

Aircraft, Automobile and Engineering Industries	Cores for winding metal foil, paper, etc.	Ball race cages
	Suspension rods for festoon driers	Fan blades
	Jigs and templates	Nuts and Bolts
	Bench tops. Water lubricated bearings	Cams, Friction rings and discs
	Piston rings	Blanks for gear wheels
		Cores for meteorological graphs
Electrical Industry	Panels. Punched parts for telephone apparatus. Tubes and transformer cylinders	insulators and terminals
		Sleeves. Contact arms
	High voltage bushings,	Tie rods. Washers
		Brush holder insulation. Formers
Refrigeration Industry	Inner door panels —flat or moulded	shapes
		Breaker strips
Textile Industry	Bobbins and bobbin tubes	Spinning cylinders
	Washers for reel seals	Gumming cylinders
		Rollers, etc

***There is nothing quite like Paxolin — the adaptable material**

m and i

THE MICANITE & INSULATORS CO., LTD.,

Empire Works, Blackhorse Lane, Walthamstow, London, E.17. Tel.: Larkswood 5500. Grams: Mytilite, Easphone, London.

INSULATION FOR THE SAFE AND EFFECTIVE CONTROL OF ELECTRICITY. MICA AND MICANITE, EMPIRE VARNISHED CLOTHS AND TAPES, "PANILAX RESIN" MOULDINGS

'PAXOLIN' and 'PANILAX' are Registered Trade Names of The Micanite & Insulators Co., Ltd.

ESSENTIAL TO ENGINEERS

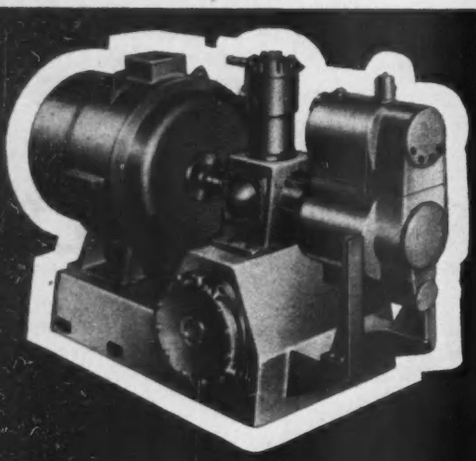
PARTS LISTS
INSTRUCTION MANUALS
PUBLICITY LEAFLETS
PRE-PRINTED DRAWING SHEETS

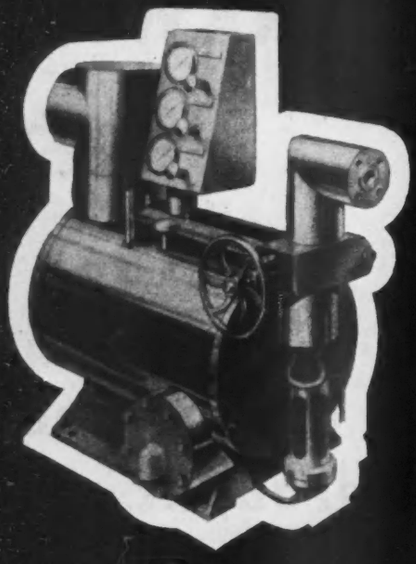
Go to printers who understand the requirements of engineers and who have draughtsmen, designers and artists available for the production of all types of engineering literature.

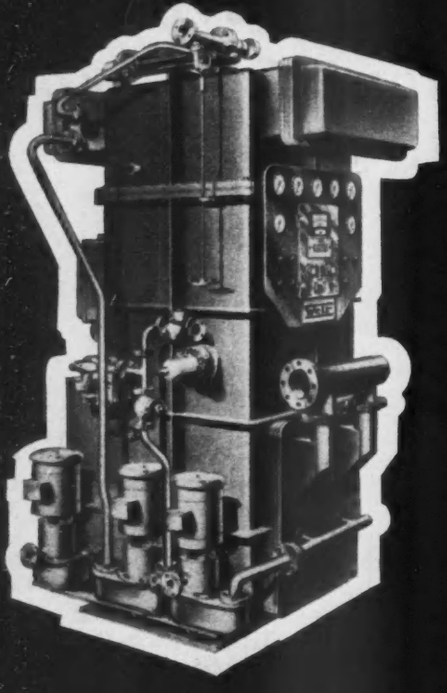
E. N. MASON & SONS LTD.

ARCLIGHT WORKS, COLCHESTER, ESSEX	Telephone: Colchester 5191
SENTINEL HOUSE, SOUTHAMPTON ROW, LONDON, W.C.1.	Telephone: Clerkenwell 4064
28-31 DALLINGTON STREET, LONDON, E.C.1.	Telephone: Clerkenwell 4064
13-15 ST. VINCENT PLACE, GLASGOW, C.1.	Telephone: Central 3775
8-10 NEWTON STREET, MANCHESTER, 1.	Telephone: Central 9221
BROUGHTON WORKS, BLACKBURN STREET, SALFORD, 3.	Telephone: Deansgate 3942
ALBERT ROAD, STECHFORD, BIRMINGHAM, 33.	Telephone: Stechford 4442
14 COOK STREET, LIVERPOOL, 2.	Telephone: Central 6514
51 VICTORIA STREET, SHEFFIELD, 1.	Telephone: Sheffield 21776
6 BRITANNIA HOUSE, WELLINGTON STREET, LEEDS, 1.	Telephone: Leeds 23537
3 UNITY STREET, BRISTOL, 1.	Telephone: Bristol 92441

STRIKING NEW EQUIPMENT BY







Weir

to be introduced at
the Engineering, Marine Exhibition

NEW STARTING AIR COMPRESSOR

Of two-stage design, with rotary first stage and reciprocating second stage. This arrangement reduces the number of reciprocating parts, and saves up to 25% space and 40% weight over conventional sets. A multi-purpose air and oil cooler is housed in the bed plate. For discharge pressures up to 600 p.s.i.g. and capacities up to 150 cu. ft./min. of free air.

NEW TURBO-PUMP UNIT

A single-stage, turbine-driven boiler feed pump of advanced design, running at 10,000 r.p.m. There are no glands, stuffing boxes or mechanical seals, and oil lubrication is eliminated. The shaft bearings are lined with a material specially developed for water lubrication. It is smaller and less than half the weight of the ordinary turbo-feed pump.

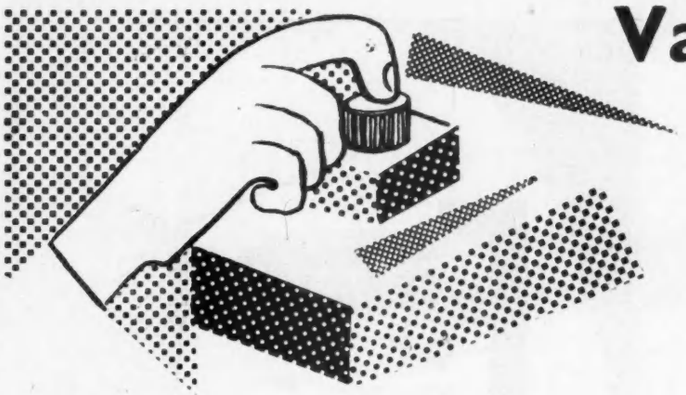
NEW VERTICAL MARINE EVAPORATOR

A vertical "packaged" unit with all ancillaries built-in. The unit is complete, requiring only the connection of water, steam and electrical services. It produces distillate of very high purity, due to the patent Weir vapour-scrubber, and employs the well-tried "Thermoflex" heating elements.

We invite you to visit our stand
No. 3, ROW F, GRAND HALL,
OLYMPIA, 16th-30th APRIL.

Weir

G. & J. WEIR LTD · CATHCART · GLASGOW, S.4.



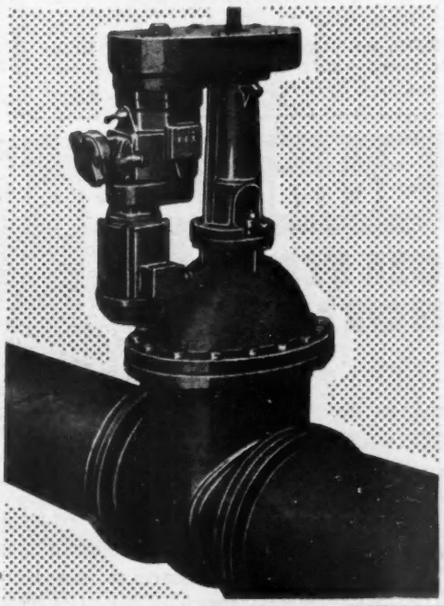
Valve control at your finger tips

By R.X. ELECTRIC SERVO MOTOR, a **SADI** product specially designed for manual or automatic remote operation.

Motorization of a 12 inch valve at 150 p.s.i. for £150

Just a typical example of what can be achieved with one of our units selected from over twenty mass produced actuators ranging from ⅛ to 7 h.p.

ADAPTABILITY TO EXISTING VALVES— IMMEDIATE DELIVERY



½ h.p. servo-motor fitted to valve in water circuit by means of patented universal support; the valve remained in operation throughout erection of unit.

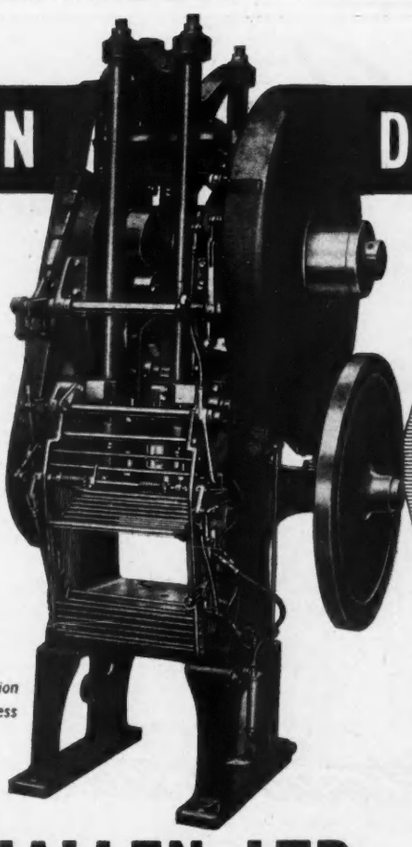
Sales and Service Organization in the Commonwealth and throughout the world.

SADI ENGINEERING CO. LTD.

10-14 ANSDELL STREET — KENSINGTON SQUARE — LONDON, W.8

Telephone: WEStern 7653. Cables: SADIUNIT, LONDON.

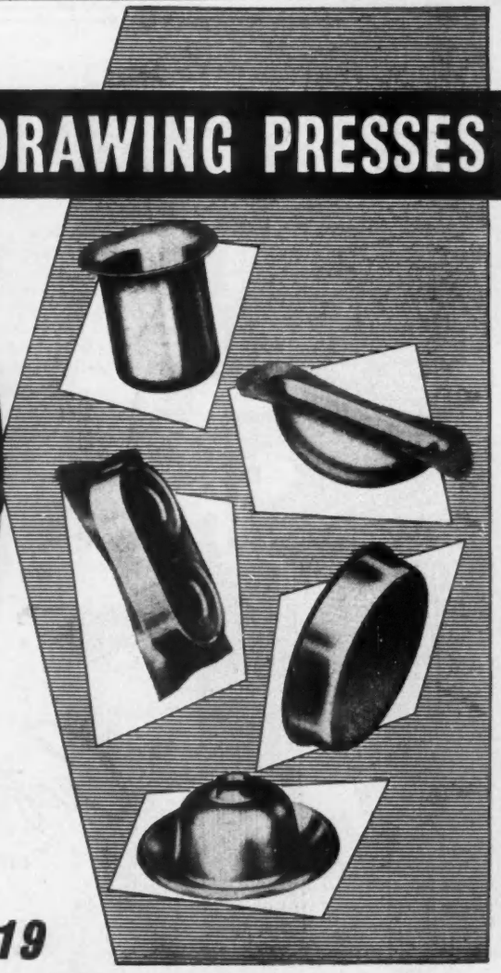
DOUBLE ACTION DRAWING PRESSES



WE ALSO MAKE

Power Screw Presses
Open-fronted Presses
Double sided Presses
Single and Double Crank Presses
All types of Automatic Feed Presses
Minting machinery
Cartridge machinery

Size 3½ Double Action Drawing Press



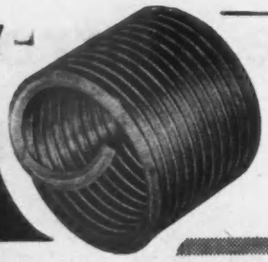
MEMBER

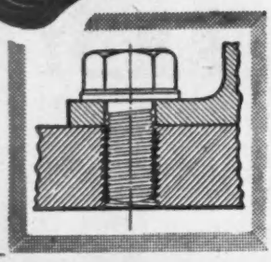
TAYLOR & CHALLEN LTD

BIRMINGHAM 19

Better than New with a ....

Cross





BRITISH WIRE THREAD INSERT

PRECISION MADE in CARBON STEEL for ALUMINIUM and MAGNESIUM.

We also make Stainless and Bronze for other applications.

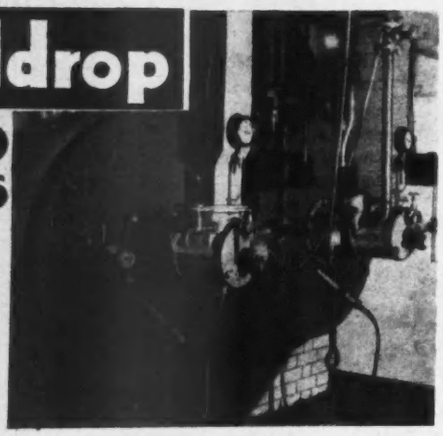
CROSS MANUFACTURING CO. (1938) LTD.

Tel: Combe Down 2355-8 BATH, SOMERSET Grams: Circle, Bath

Specialists in JET ENGINE LABYRINTHS, CIRCLIPS, SPRING WASHERS, SPRINGS, etc.

Schieldrop

OIL FIRED BOILERS



We Guarantee

13½ to 14 per cent CO_2 with Shell Smoke number 4 or less.

Write for Catalogue quoting Reference A/11

Schieldrop & CO. LTD

STOTFOLD, BEDS. Tel. 414 (4 lines)

OFFICES AT: BIRMINGHAM · LONDON · MANCHESTER SWANSEA · GLASGOW

BMJ

Famous for Forgings

of

all descriptions in alloy and Carbon Steels

(all heat treatment facilities)

T.S FORSTER & SONS LTD

FORGEMASTERS AND ENGINEERS

COPPERAS BANK FORGE, SUNDERLAND

TEL: 2876 'GRAMS: 'FRAMES' S'LAND

Craftsmanship comes the hard way...

If over 90 years spent in the design, fabrication and erection of structural steelwork means anything—it means you can place this work in our hands knowing it will progress smoothly to completion. Large job or small, we have the resources to handle all your needs. We welcome the opportunity of serving you.

Craftsmen in steel..

ESTABLISHED 1867

WALKER BROS LIMITED *Structural Engineers*

WALKER BROS. LTD. WALSALL, STAFFS Telephone: WALSALL 3136

LONDON OFFICE: 66, VICTORIA STREET, S.W.1 Telephone: VICtoria 3926

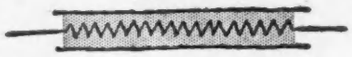
Electrical Aids in Industry *Data Sheet* **No. 4**

Resistance Heating-1

In this form of heating, the heat is produced by passing an electric current through a high resistance conductor which is termed the " heating element ".

The heat is transferred from the heating element to the work by convection, radiation or conduction, or by a combination of any, or all of these. When it is a question of radiation or convection, the element can be a bare wire or strip of suitable material, provided it is adequately supported on electrical insulation capable of withstanding the temperature.

When there is to be contact between the work and the element, heat being transferred to the work by conduction, the wire or strip must be surrounded by suitable insulating material and enclosed in a protective sheath.



In the majority of cases, the wire or strip forming the heating element is made of a nickel-chromium alloy which has a high electrical resistance and can be safely used in air at temperatures of up to 1050°C., or in a suitable atmosphere, of up to 1150°C. Other element materials are available for use at higher temperatures.

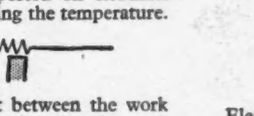
Sheathed elements, essential for contact heating but also used widely for convection and radiation heating because of the convenience afforded by the mechanical strength of the sheath, usually metallic, and by their "built-in" electrical insulation, cannot be used at temperatures as high as the bare wire or strip. This is because the wire, being embedded in insulation, is always at a higher temperature than the sheath, and to keep the wire temperature down to a safe figure the sheath temperature is usually limited to a maximum of around 800°C.

Automatic temperature control of resistance heating elements within narrow limits is easily effected, but if manual control only is desired, devices are available which enable the heat output of the elements to be controlled precisely at a required level. As with all electrical methods, a time switch may be included in the control circuit for automatically switching on or off at predetermined times, and this can enable, for example, an electric oven to be fully up to working temperature by the time the working day starts. Since there are no combustion products from the heaters, there is no need to build flues or special ventilating arrangements which also carry away useful heat.

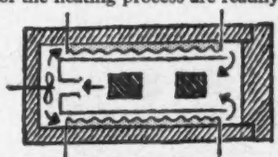
Electric resistance heating may profitably be put to many diverse uses; two of these are described briefly below, others will be listed in a subsequent data sheet.

Furnace Heating

Electric resistance furnaces can be divided into two main categories, batch type and continuous. In most cases, the heating elements are of nickel-chromium alloy, for furnace temperatures up to around 1050°C., but higher temperatures, up to nearly 3000°C., can be obtained by using other metals or alloys, or in some cases non-metallic elements. A protective atmosphere is desirable to prolong the life of some of these higher-temperature elements. For all temperatures, electric resistance furnaces can be constructed so that the heating process takes place in a controlled atmosphere if this is dictated by the composition or heat requirements of the work charge. In some furnaces, fans are used to circulate the air or special atmosphere over the charge, thereby giving increased heating rates and a uniform temperature over the whole charge.



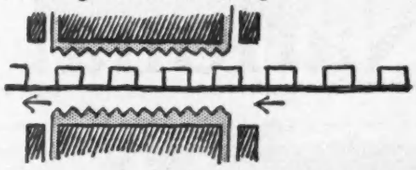
Automatic temperature control and programme control of the heating process are readily effected.



Electric furnaces are extensively used in industry, for example in the general heat treatment of metals, in the glass and ceramics industries, for brazing and sintering, and for many other applications requiring temperatures above 500°C.

Oven Heating

There are two basic forms of heat transfer used in electric resistance ovens: convection and radiation. The latter is dealt with in a separate data sheet under the heading " Infra-Red Heating ".



Convection ovens may again be of the batch or continuous type. In either case, the charge is heated mainly by the movement of hot air, which is sometimes assisted, as in furnaces, by fans to give a rapid and uniform temperature rise. Ovens are normally designed for temperatures of up to about 500°C., and the heating elements are invariably of nickel-chromium or nickel-chromium-iron alloy.

Ventilation, when required, can be provided and regulated entirely to suit the heating process. Temperatures and times are readily controlled. A vacuum can be maintained in suitably designed ovens to assist in the extraction of moisture and solvent.

Convection ovens are extensively used for drying, baking and stoving operations, and for a host of other processes requiring a low or medium temperature.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, W.C.2.

Excellent reference books on electricity and productivity (8/6 each, or 9/- post free) are available—"Induction and Dielectric Heating" is an example; "Resistance Heating" is another.

E.D.A. also have available on free loan a series of films on the industrial use of electricity. Ask for a catalogue.

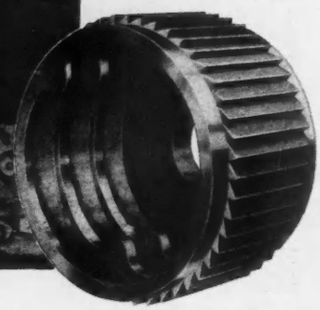
6780

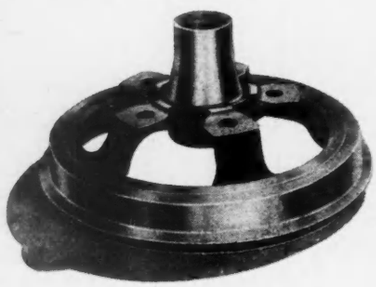
CUT HERE

N S F

STEEL CASTINGS

For over 40 years, many firms whose names are household words in their respective fields have continued to use N.S.F. castings. This in itself is justification for the claim that there are no better castings poured than those produced by N.S.F. The N.S.F. is not just a modern foundry supplying black castings, but offers all the facilities of a well equipped machine shop, capable of machining the most intricate castings to precision limits on a production basis.



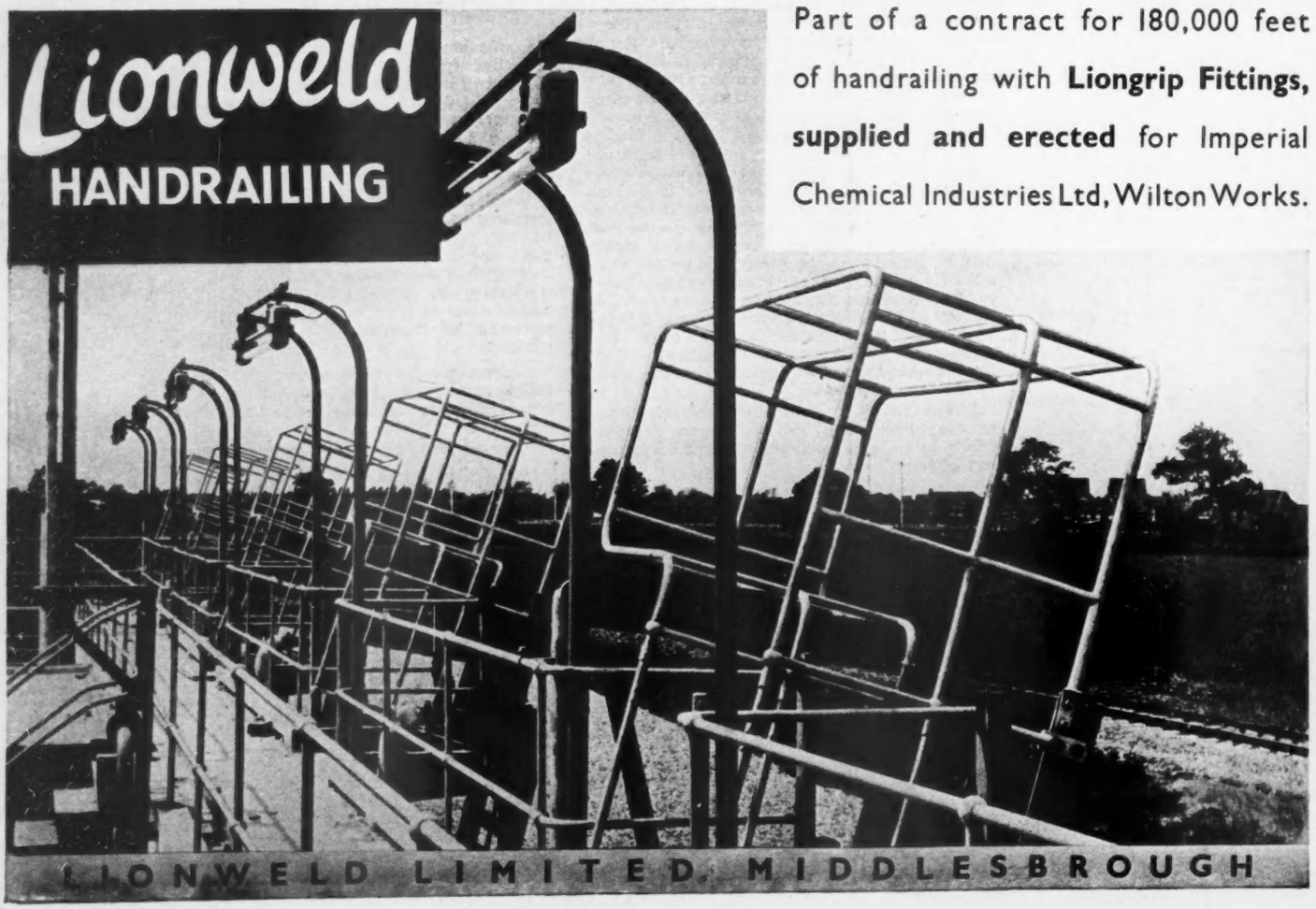


National Steel Foundry

(1914) LTD. KIRKLAND WORKS, LEVEN, FIFE. PHONE LEVEN 693. LONDON OFFICE, ALEXANDRA HOUSE, KINGSWAY, W.C.2

Lionweld HANDRAILING

Part of a contract for 180,000 feet of handrailing with **Liongrip Fittings, supplied and erected** for Imperial Chemical Industries Ltd, Wilton Works.



LIONWELD LIMITED, MIDDLESBROUGH

HILL & JACKSON (SPRINGS) LTD.

MANUFACTURERS OF

HIGH CLASS SPRINGS FOR ALL PURPOSES

A large range of coil and flat springs. One off or bulk production to specification

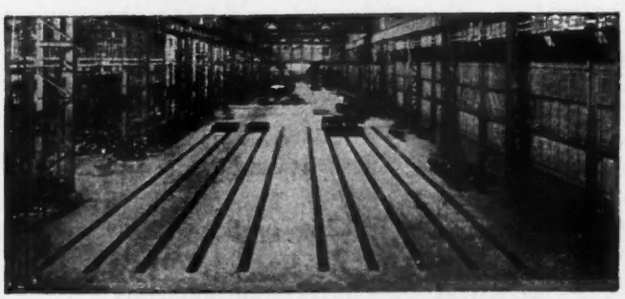
SWAN LANE · WEST BROMWICH

TELEPHONE: 0862-3 WEST BROMWICH TELEGRAMS: FLEXIBLE, WEST BROMWICH

Ironite

THE PROVED CONCRETE HARDENER

ESTABLISHED 1912



General Engineering Shop, Messrs. Vickers-Armstrongs Ltd.; Barrow-in-Furness

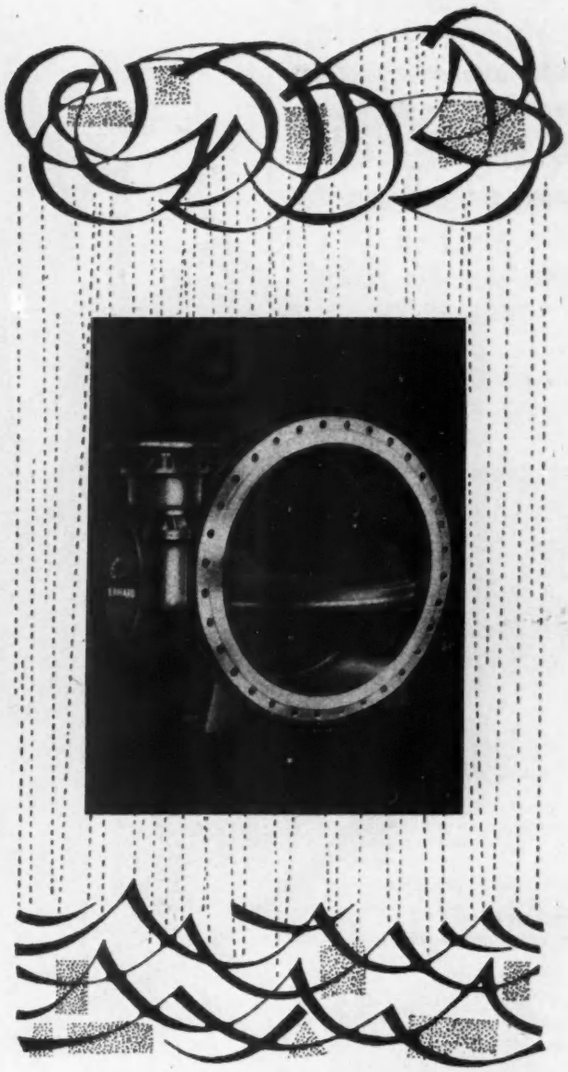
RECENT CONTRACTS INCLUDE:—Vickers-Armstrongs, Ltd., Barrow Island, 95,000 sq. yds. English Steel Corporation, Appleby-Frodingham Steel Co. Sheffield Twist Drill & Steel Co., 1,000 sq. yds. The Austin Motor Co., Standard Motor Co., Coventry. Convoys: Deptford, 8,400 sq. yds. Fulham, 4,000 sq. yds. Ferranti Ltd., Manchester. United Canners, Boston. Tank Hangers: Warminster, I.C.I., Grangemouth. British Oxygen Company. R.E.M.E. Workshops for Tanks, Stirling. S.P.D. Depot, Aylesford. Chivers Ltd., Histon. Colleges of Further Education: Accrington, Morecambe, Leigh. B.E.A. Gen. Stations: Southwark, Poole, Dartford, Llynfi, Deptford, Blackpool, East Yelland, Wandsworth. Docks: 21 Shed, Royal Albert Dock, No. 3 Shed, King George V Dock. Bus Depots: Portsmouth, Liverpool, Derby.

Write for Brochure to:—

THE IRONITE CO. LTD.

4 HOLBEIN PLACE, SLOANE SQUARE, LONDON, S.W.1

Tel: SLOane 4777



CLOUDS AND OCEAN

are the limits within which water is bound to circulate. Man is taking possession of this element of life from the source to the mouth of rivers. In order to make it subservient to him he must control, direct and regulate it. Up-to-date engineers solve this problem with

ERHARD-ABSPERRKLAPPEN

German and Foreign Pat. metallic seals

- No attendance after installation
- Absolute leaktightness in closure
- Smooth operation
- Low head room
- Short overall length

ERHARD

JOHANNES ERHARD H. WALDENMAIER ERBEN

Süddeutsche Armaturenfabrik Heidenheim an der Brenz (Western Germany)

For all information write to:

The Sole Agents for the United Kingdom

A. K. STARCK'S CO. LTD. 22, Chancery Lane, London, W.C.2

Telephone: Holborn 2966 Cable: Akstar London

IS CORROSION COSTING YOU MONEY?

WHEREVER corrosion attacks plant or buildings it also attacks your pocket. It can be the cause of constant repair, mounting costs, interruption of production while repairs are being effected. So wherever processing involves chemicals of a corrosive nature get SEMTEX, the anti-corrosion specialists, to proof factory floors, storage bays, machine beds and, where necessary, walls against corrosion. SEMTEX have specialised in this work for many years and can give the best possible advice on the subject before suggesting the type of anti-corrosion treatment your plant needs. Consult

This free book will give you full details of the SEMTEX Anti-corrosion Service — write for it today!

Semtex INDUSTRIAL DIVISION

Specialists in anti-corrosion treatments and industrial flooring

SEMTEX LIMITED, INDUSTRIAL DIVISION, DEPT. E.4, 50 BLACKFRIARS ROAD, SALFORD 3, LANCASHIRE. TEL: DEANSGATE 2128

CPH 6.59/1/2

Fine Woven Wire

up to the finest mesh

in any commercial metal

Plain & twilled weave Hollander cloths

BY Greenings

H. GREENING AND SONS LTD. Established 1799

BRITANNIA WORKS
WARRINGTON · ENGLAND
P.O. BOX 22

Telephone: WARRINGTON 32401 Telegrams: GREENINGS WARRINGTON
TELEX No. 62195

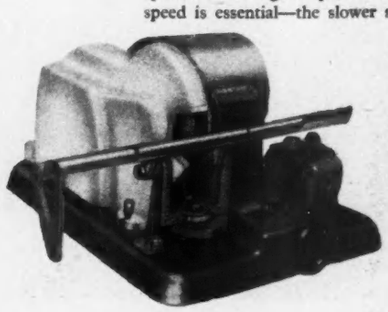
Also: BRITANNIA WORKS, HAYES, MIDDX. Telephone: HAYES 3961 Telegrams: GREENINGS, HAYES

NG.84

CUTTING-OFF machine

This cutting-off machine is suitable for material up to 1½" dia. and is available in two speeds. The higher speed for brass and other non-ferrous tubes and bars where high speed is essential—the slower speed is for non-ferrous materials. Each has an infinite variable speed range within the maximum and minimum speed. This is easily obtained by turning a handle and reading off from a graduated r.p.m. scale.

Material is held in a cradle which is adjustable to give mitre cutting and a scale gives graduated readings for different angles. A stop bar, with micro-adjustment, is also fitted on the cradle. Cutting is achieved by pushing the cradle in an arc to the cutting saw. The Tubeman 'BANTAM' is ideal for repetition work using unskilled labour.



price from £42 · 10 · 0

TUBEMAN 'BANTAM'

TUBEMAN STAINLESS LTD

Ossian Works, Ossian Road, Stroud Green, London, N.4 Phone: FITzroy 0338

★ See THOS. P. HEADLAND STAND No. 9 Grand Hall Gallery Outer Row

DaT24459E

HAMMERED OR HYDRAULIC PRESSED

FORGINGS

IN STEEL
BLACK OR MACHINED
TO 24 TONS

THE INCE FORGE CO. LTD.
WIGAN PARKS FORGE LTD. PROPRIETORS

NORRIS BROS. LTD.

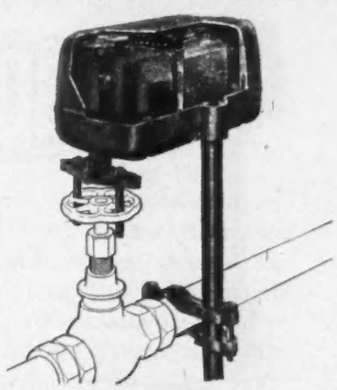
have teams available to undertake

DESIGN, DETAILING and DEVELOPMENT

in the following fields :-

Aeronautical Engineering
Chemical Plant
Electrical Engineering
Mechanical Engineering
Mechanical Handling
Model Making
Nuclear Engineering
Plant Layout
Production Tooling
Servo Mechanisms, Automation
Special Machines and Projects
Structure and Reinforced Concrete, etc.

53 VICTORIA STREET S.W.1
– TEL. ABBEY 6132 –



VALVE MOTORISATION by ROTORK

Rotork electric actuators can be operated by push button, or automatically from any distance.

The "Junior" model illustrated (type 1F) will operate any valve with a handwheel which a man can close with one hand. No modification to the valve is needed.

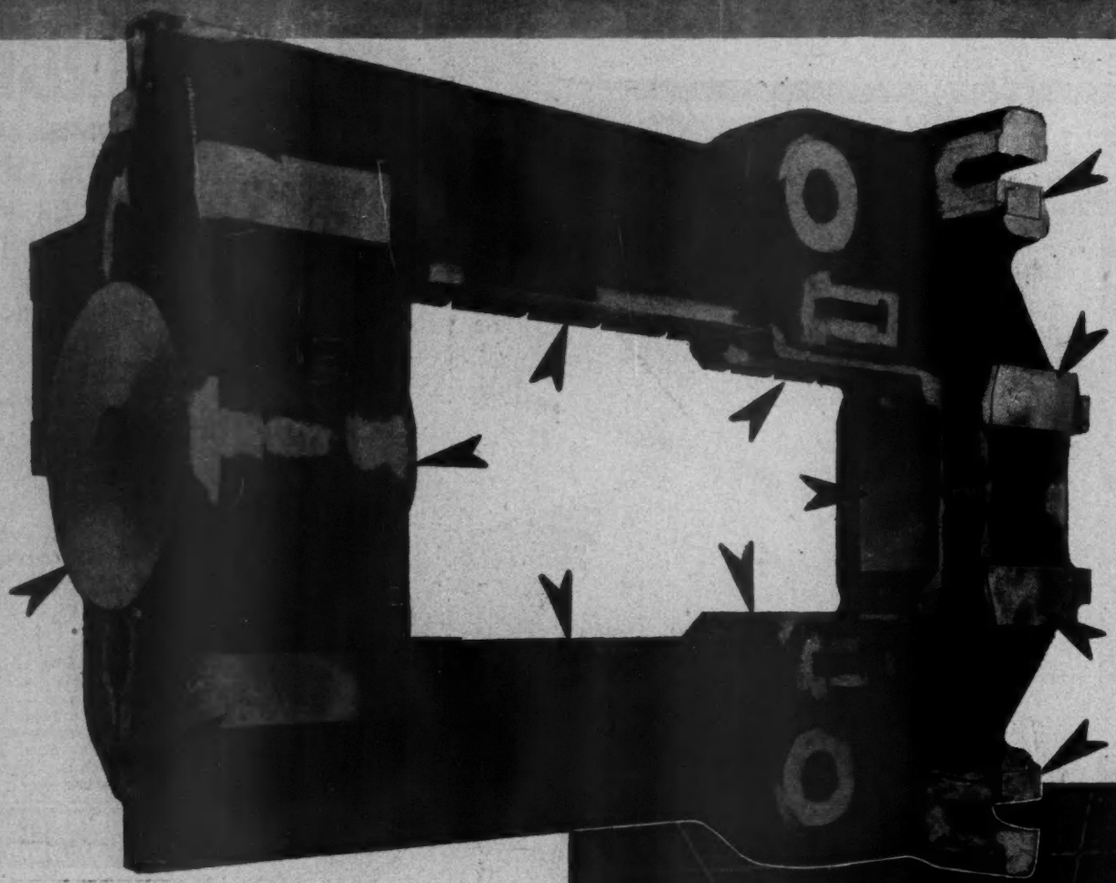
A worm and spur type reduction gear box, grease packed and totally enclosed in a weatherproof case, is driven by a small universal type motor suitable for 200-250V. A.C. single-phase supply.

Examples of typical sluice valve applications are : ½" at 2,000 p.s.i., 1" at 400 p.s.i., 2" at 125 p.s.i., and 3" at 30 p.s.i.

Full information about this and other Rotork actuators supplied on request.

ROTORK ENGINEERING CO. LTD.
BATH · Telephone : 64558

ALL THESE FACES MILLED AT ONE SETTING!



on this ASQUITH *machine*

The illustration above shows a mill housing which has been machined on the end, front and window faces at one setting on the Asquith 7in. spindle Ram Type Horizontal Milling and Boring Machine. Exceptional rigidity and accuracy for heavy duty cutting or match milling is ensured by the 16in. diameter driving flange of the milling sleeve, fully supported by the large section ram. The machine can be operated from the pendant and many new design features, such as steering control for milling surfaces of irregular outline or large circumference, are incorporated whereby this Asquith machine may be regarded as the most up-to-date machine of its type for heavy engineering work.

WILLIAM ASQUITH LTD.
HALIFAX · ENGLAND

Sales & Service for .. **DRUMMOND-ASQUITH** *... the British Isles*

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM

'Phone: Midland 3431 (7 lines) 'Grams: Maxishape, Birmingham. Also at LONDON : 'Phone : Trafalgar 7224 (5 lines) and GLASGOW : 'Phone: Central 0922

A 318

DOWTY

MOULDINGS and BONDINGS

Natural, synthetic and silicone rubbers and P.T.F.E.

DOWTY SEALS LIMITED · ASHCHURCH · GLOS.

ENGINEERS - *don't read this!*

unless YOU ARE INTERESTED IN

- CLOSE SCIENTIFIC CONTROL in manufacture.
- GREATER SOUNDNESS in material.
- BETTER SURFACE FINISH in machining.
- MAXIMUM SATISFACTION in use.

IF YOU ARE INTERESTED . . .

Please write to us for Publication ***TS 58*** *illustrating some of the Modern means at your disposal in the supply of*

BRONZE CASTINGS

AS BLANKS ONLY OR FINISH MACHINED

JOHN HOLROYD & CO. LTD. P.O. BOX 24, HOLFOS WORKS, ROCHDALE, LANCS.

TELEPHONE ROCHDALE 3155 MAKERS OF HOLFOS BRONZE

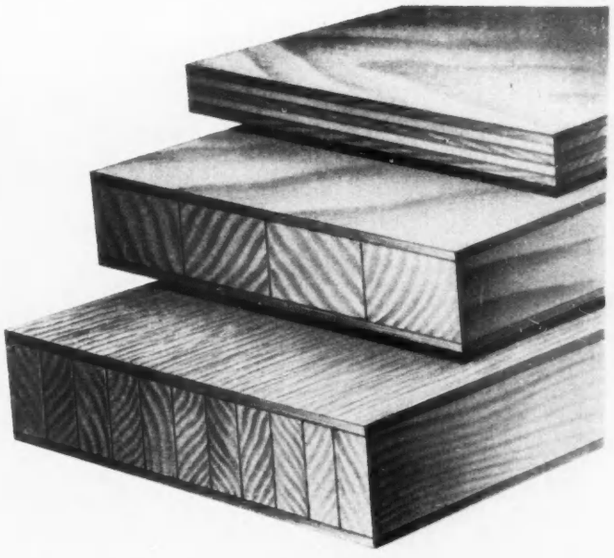
HL 15

Right from the start.....

SINCE THE END OF THE 19th CENTURY when the development of the rotary cutter made possible the cutting of large sheets of veneers,

WE BEGAN TO STOCK

PLYWOOD



Range of thicknesses

PLYWOOD
from 1/16" to 1"

BLOCKBOARD
from 16 m/m. to 25 m/m. (5/8" to 1")

LAMINBOARD
from 13 m/m. to 51 m/m. (1/2" to 2")

Our expert advice is at your disposal, and a service to meet large or small requirements, from depots in various parts of London.

C. F. ANDERSON & SON LTD.

TIMBER AND PLYWOOD IMPORTERS

ISLINGTON · LONDON · N.1. Tel: CANonbury 1212 (28 lines)

A NEW AND IMPROVED RANGE of CORROSION RESISTING CEMENTS

with
Improved Resistance,
Greater Adhesion,
Lower Porosity,
Longer Life,
Greater Compressive Strength

For use on all corrosion resisting constructions

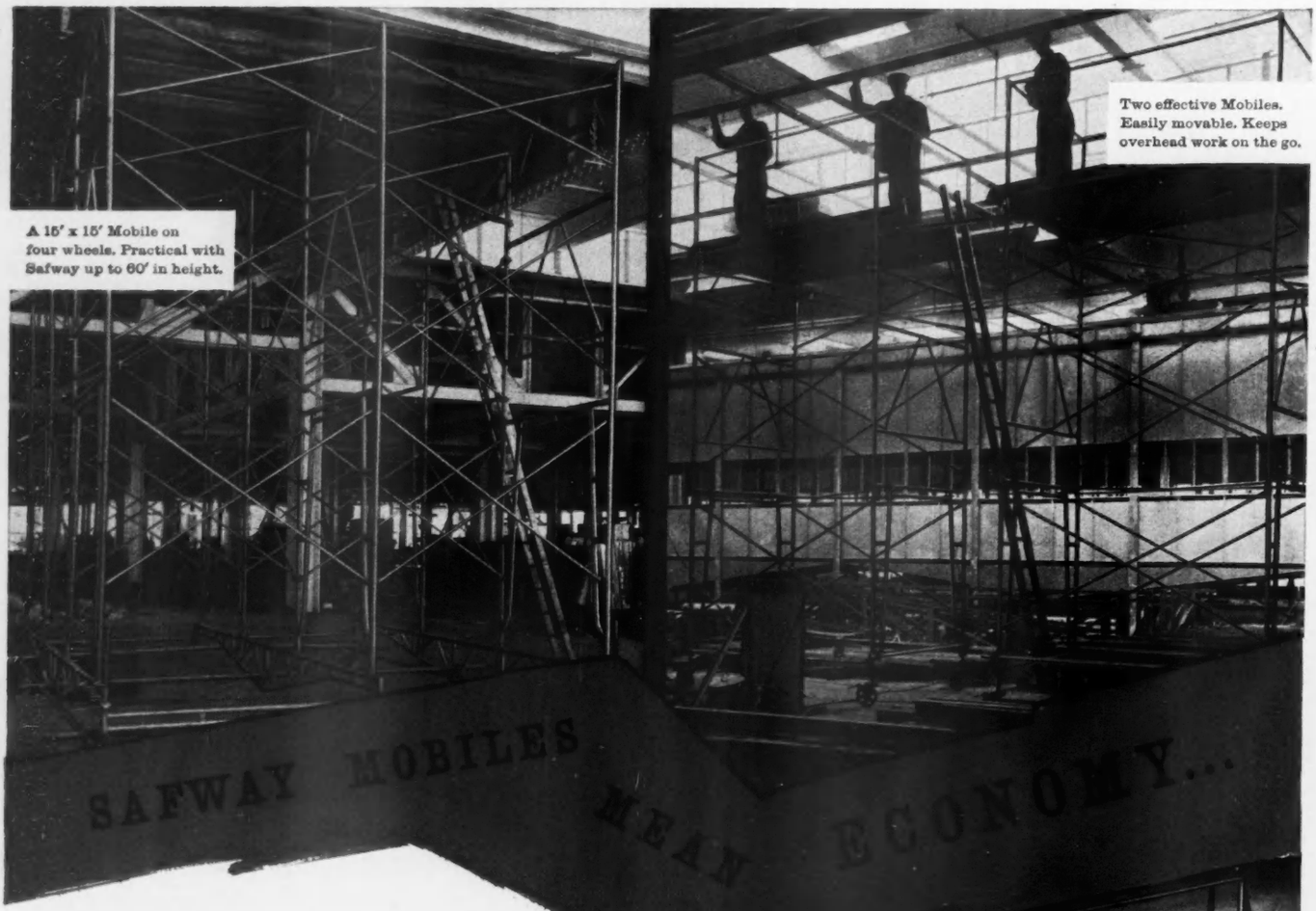
Pickling Tanks,
Neutralising Tanks,
Piers & Tank Bases,
Acid Resisting Floors,
Channels, Sumps etc.

Covered by World Patents
Manufactured exclusively in Great Britain by:—

PRODORITE LTD

EAGLE WORKS
WEDNESBURY
TELEPHONE : WED 1821 9 lines

WRITE NOW FOR OUR BROCHURE ON THIS NEW AND IMPROVED RANGE OF CORROSION RESISTING CEMENTS



A 15′ x 15′ Mobile on four wheels. Practical with Safway up to 60′ in height.

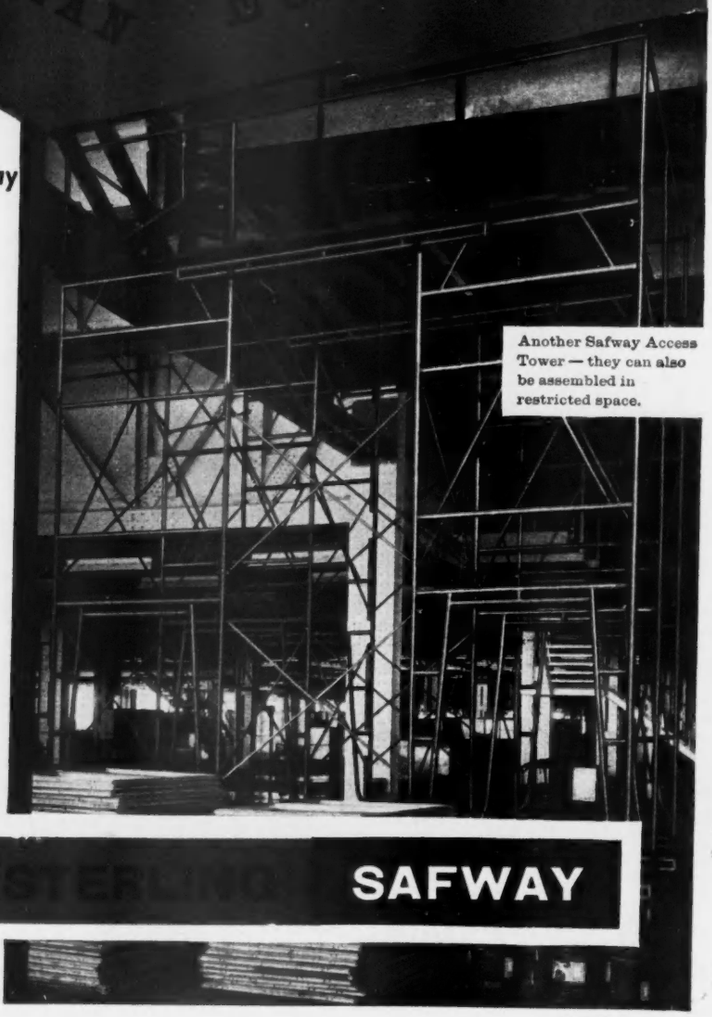
Two effective Mobiles. Easily movable. Keeps overhead work on the go.

large area access platforms

built on the spot without delay

from standard *SAFWAY* Units

The adjoining SAFWAY-in-action photographs, taken at the site of the new Assembly Division Ford Motor Co. at Dagenham, illustrate well one of the basic advantages of Safway scaffolding . . . the ease and speed with which the standard units may be assembled on the spot to produce safe stable mobile platforms, easily adjustable for height. Delays and costs are cut to the minimum. **Versatility PLUS** Remember the above is just a bonus benefit to the SAFWAY user . . . these special structures are quickly built . . . and when finished with, quickly dismantled for re-use. SAFWAY Scaffolding is faster ' up-and-down ' and is load-bearing too—first for Versatility.



Another Safway Access Tower — they can also be assembled in restricted space.

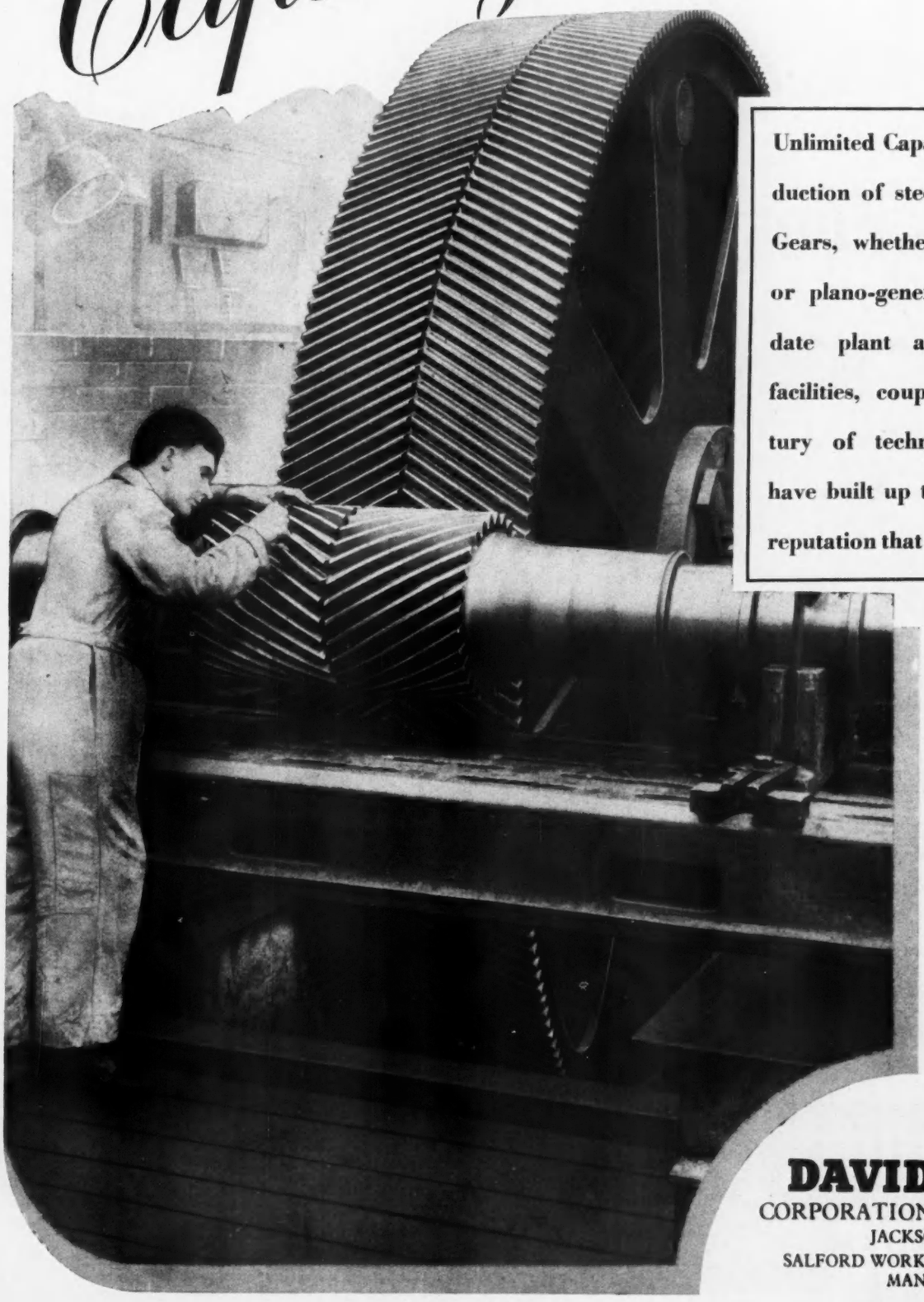
STERLING-SAFWAY

Bedford: Sterling Works, Bedford. Tel.: Bedford 5338 (3 lines)
Bristol: 175 White Ladies Road, Bristol, 8. Tel.: Bristol 39112
Edinburgh: 23 Rutland Square, Edinburgh, 1. Tel.: Fountainbridge 3254/5
Glasgow: 28 Renfield Lane, Glasgow, C.2. Tel.: City 6201/2
Jarrow: Sterling Factory, Jarrow, Co. Durham. Tel.: Jarrow 89-7721/2/3
London: Iddesleigh House, Caxton Street, S.W.1. Tel.: ABBey 3017/8 (2 lines)

STERLING SAFWAY

Corent

Capacity!



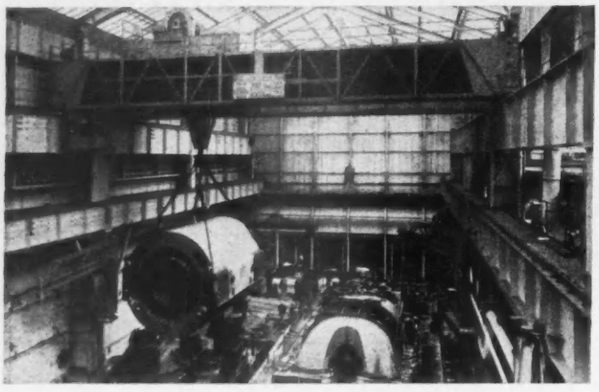
Unlimited Capacity for the production of steel Double Helical Gears, whether hobbed, milled or plano-generated and up-to-date plant and metallurgical facilities, coupled with a century of technical experience, have built up the "JACKSON" reputation that is your safeguard.

Generating large spur gears for sugar cane crushers

THE
DAVID BROWN
CORPORATION (SALES) LIMITED
JACKSON DIVISION
SALFORD WORKS HAMPSON STREET
MANCHESTER 5

D

A CLYDE BOOTH 200 TON CRANE

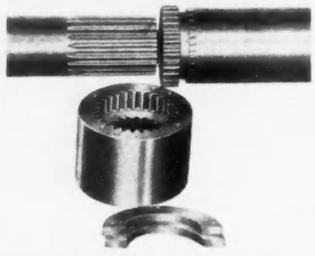


Clyde 200 tons electric overhead travelling crane in the turbo-generator erection shops of Messrs. C. A. Parsons & Co. Ltd., Newcastle.

This crane of 200 tons capacity is quite large as electric overhead travelling cranes go, but it is by no means the largest of our productions.

Not all our clients require to make lifts of this magnitude, of course, and the design and production departments of the Clyde-Booth organisation have the experience and facilities for producing a wide variety of cranes for all applications and ranging in capacity from a few tons up to the largest types required by modern industry.

* SALIENT FEATURES OF



CLYDE-BOOTH DESIGN...

SPLINED GEAR COUPLINGS *

- Supersede keyed-on flanged couplings.
- Speed up production and assembly.
- Save space.
- Simplify crane maintenance.

* *The services of an experienced technical staff are at your disposal and we are always pleased to submit proposals and designs for crane installations to suit your particular requirements.*

CLYDE BOOTH

CLYDE CRANE & BOOTH LIMITED
incorporating

CLYDE CRANE & ENGINEERING CO., MOSSEND, Lanarkshire. *Phone: Holytown 412 (6 lines)* **JOSEPH BOOTH & BROS.**, Union Crane Works, RODLEY, Leeds. *Phone: Pudsey 3168 (6 lines)*

DESIGNERS! THIS IS THE ONE REFERENCE BOOK TO SOLVE YOUR FLUID SEALING PROBLEMS — AND IT'S FREE!

When you design Fluid Seal applications, don't be without this valuable Reference Book issued by Pioneer. Prepared by practical engineers, it includes the latest up-to-date information on Fluid Seal Technology, comprehensive data on a wide variety of applications, how to install correctly with easy-to-follow illustrations for all the various types of seals produced by Pioneer, and a full range of available sizes. The Pioneer Reference Book which comes to you on request, is a practical work for the busy designer and is part of the Pioneer service which includes free advice on any Fluid Sealing problem.

Pioneer

OILSEALING & MOULDING CO. LTD

A DIVISION OF J. H. FENNER & CO. LTD

Factory and Head Office : Cottontree Works, Colne, Lancs. Tel : Wycoller 471 (8 lines)

GET YOUR COPY OF THE PIONEER FLUID SEAL CATALOGUE *NOW*

FORDSMITH OF MANCHESTER

COLLARS IN ALL SIZES

MANUFACTURED ENTIRELY FROM THE SOLID BAR IN OUR OWN WORKS!

Generously dimensioned on both width and outside diameter and fitted with unbreakable setscrew

WRITE FOR LISTS—

FORDSMITH OF MANCHESTER

SPECIALISTS IN REPETITION WORK OF EVERY KIND

H. FORDSMITH

LIMITED

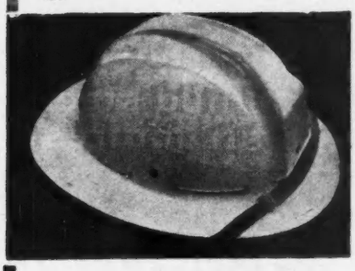
HADFIELD ST. WORKS

CORNBROOK · MANCHESTER, 16

Telephone: Trafford Park 1615-6

Keep ahead in safety . . .

with the eversafe



Everoak

SAFETY HELMETS

EVEROAK Safety helmets are manufactured under British Standard Licences—your guarantee of a first-class safety product.

PRICE 17/6 EACH

EVEROAK gives complete head protection for those working in: Quarries, Mines, Building Sites, Ship Yards, Refineries, etc., etc.

AVAILABLE IN VARIOUS COLOURS. WRITE FOR FULL DETAILS TO:

EVERITT W. VERO & CO. LTD

EAST DULWICH ROAD · LONDON S.E.22

THE **LEEDS & BRADFORD BOILER Co** LIMITED

STANNINGLEY

★

AUTOCLAVES & VULCANISERS

with Pat. *Quicklock* door

CHEMICAL PLANT, CREOSOTING PLANT, VACUUM DRYING & IMPREGNATING PLANT, HYDRAULIC PRESSWORK.

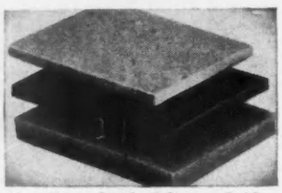
PRESCOLASTIK
REGD.

SILICONE RUBBERS

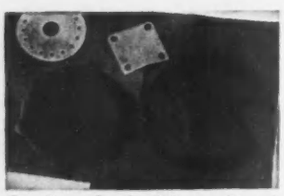
The most comprehensive range available

TAKE ADVANTAGE of the technical resources and production facilities of the most modern silicone rubber plant in the United Kingdom.

A. Prescolastik Expanded Silicone Rubber. Uses: Soft Gasketing, Vibration Damping, Seals, Pads and Dampers.



B. Prescolastik Silicone Rubber Sheet. Uses: Gaskets, Seals, Diaphragms, Washers, etc.



C. Prescolastik Silicone Coated Fabrics. Uses: Diaphragms, Gaskets, Seals, Tapes, Ductings and Flexible Low Temperature Coverings.

Prescolastik silicone rubbers offer the widest available range of compounds to meet the most exacting conditions.

General Purpose Grades
Low Temperature Grades
Low Compression Set
Fuel and Oil Resistant Grades
Silicone Coated Fabrics
High Tensile Grades
High Temperature Grades
H.T.P. Resistant Grades
Cellular Rubbers

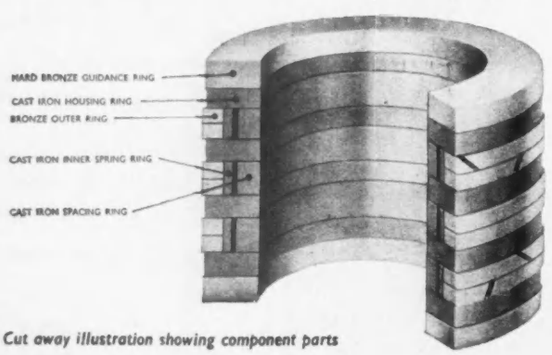
Designers and Engineers are invited to write to us for technical data.

PRECISION RUBBERS LIMITED
BAGWORTH, LEICESTER, ENGLAND
Telephone: Bagworth 241

STANDARD'S

BUILT-UP PISTON ASSEMBLY

For HYDRAULIC WORK AND HIGH PRESSURE SEALING



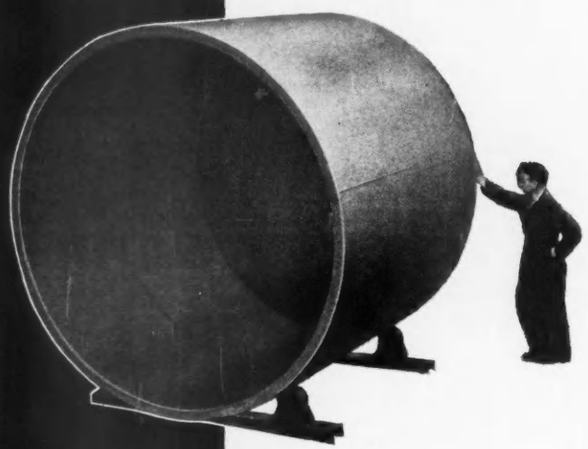
Cut away illustration showing component parts

ADVANTAGES OF STANDARD'S BUILT-UP PISTON ASSEMBLY

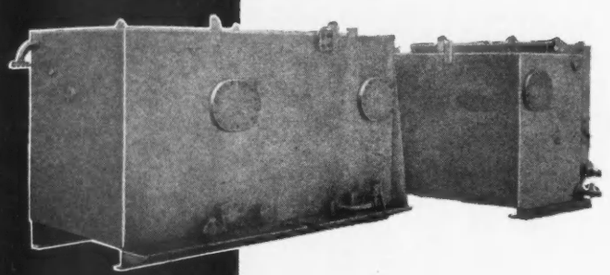
- All faces of assembly precision ground, permitting clearances to be reduced to a minimum.
- No possibility of ring distortion due to springing over solid piston.
- Any length of assembly can be built up to suit customers' requirements.

THE STANDARD PISTON RING & ENGINEERING COMPANY LIMITED Established 1893
PREMIER WORKS · DON ROAD · SHEFFIELD 9 · ENGLAND
Telephone: Sheffield 42076-7-8 (3 lines) *Telegrams: Ocean Sheffield 9*

TANKS any shape



TANKS any size



TANKS electrically welded

. . . and mild steel weldments and structures

Markland Scowcroft LTD

BROMLEY CROSS, Near BOLTON *Phone EAGLEY 600 (5 lines)*

STEEL SHELVING

72" HIGH **34" WIDE** **12" DEEP**

★ *Brand new — Manufactured in our own works.*
★ *Shelves adjustable every inch.*
★ *Heavy gauge shelves will carry 400 lbs. each.*
★ *6 shelves per bay — Extra shelves 8/- each.*
★ *Stove enamelled dark green.*
★ *Quantity discounts.*
★ *Also available in white at £5 per bay.*

£3 • 15 • 0 ***DELIVERED FREE!***

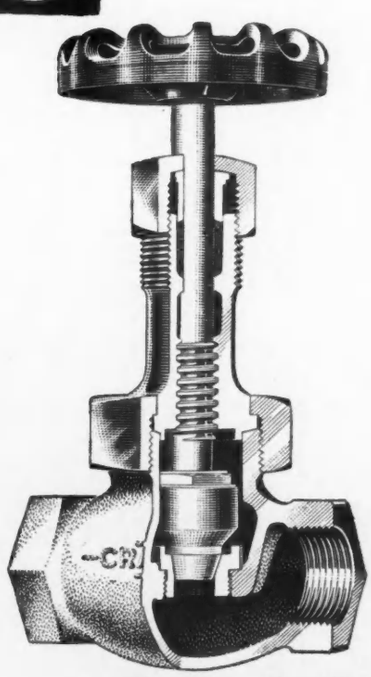
Ready for Erection in England, Scotland & Wales

ALL OTHER SIZES available at equally keen prices.

N. C. BROWN LTD.

GREEN LANE STEELWORKS
HEYWOOD, LANCASHIRE
Tel. 69018 (6 lines)

C



You might like to file this J.

BULLETIN ON CRANE BRONZE GLOBE VALVES

. . . featuring the D46, with renewable Nickel Alloy Disc and stainless steel seat ring.

Designed for services under really rigorous conditions and made to British Standard 2060. The plug type nickel alloy disc and stainless steel seat ring make an extremely tight closure whilst allowing close regulation of flow when throttling. The two dissimilar metals offer the best resistance to corrosion and damage by foreign matter. Both disc and ring are renewable. Working pressures (valves with screwed ends): up to 250 pounds (steam 500°F); 500 pounds (water, oil or gas, cold, non-shock).
Screwed Hexagon ends with British Standard Taper Threads—or to American Standards. Flanged in accordance with British Standard Tables 'F' or 'H'—or to American Standards.
Sizes: Screwed ¼" to 3"—Flanged ½" to 3"
Sizes 2½" and 3" have bolted bonnet.

CRANE VALVES OF BRONZE CAST IRON AND CAST STEEL

CRANE LTD., 15-16 RED LION COURT, FLEET ST., LONDON, E.C.4 WORKS: IPSWICH *Branches: Birmingham, Brentford, Bristol, Glasgow, London, Manchester*

V17

A SELF-CONTAINED PORTABLE SYSTEM OF INSTRUMENTATION

The NEW PENDEFORD MULTIMETER

LIGHT IN WEIGHT—SIMPLE TO OPERATE—VERSATILE

Make checks in situ at different locations with varying problems, quickly and easily with this new Multimeter. Just plug-in the appropriate transducer, set the 6-position selector switch and read off pressure, tension, load, strain or displacement on the directly calibrated scale. In addition, recording or control can be carried out and the instrument is provided with an electrical output for this purpose.

SPECIFICATION

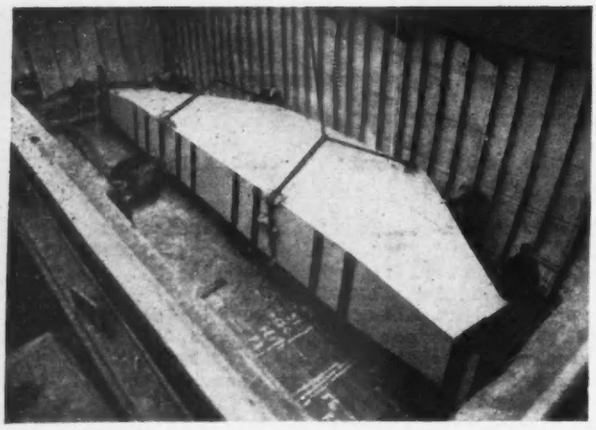
Energising supply: 5.0 v.; Max. current 200 mA; Frequency 1 Kc/s;
Electrical output ±0.15 mA full scale into 1,500 ohms load;
Mains supply 200-250 v. 50 c/s; Dimensions 15" x 9" x 6" deep; Weight (approx.) 20 lb.

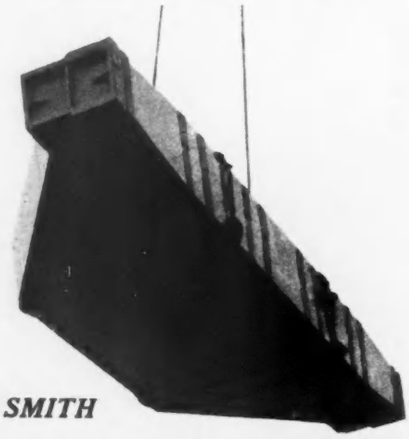
Why not write us for full details of the new Multimeter and our new type transducers? All are specially designed to simplify testing.

Typical transducers for use with the New Pendeford Multimeter.

BPA Electronics BOULTON PAUL AIRCRAFT LTD., WOLVERHAMPTON.

nothing too BIG or too HEAVY





for the ARBUCKLE, SMITH

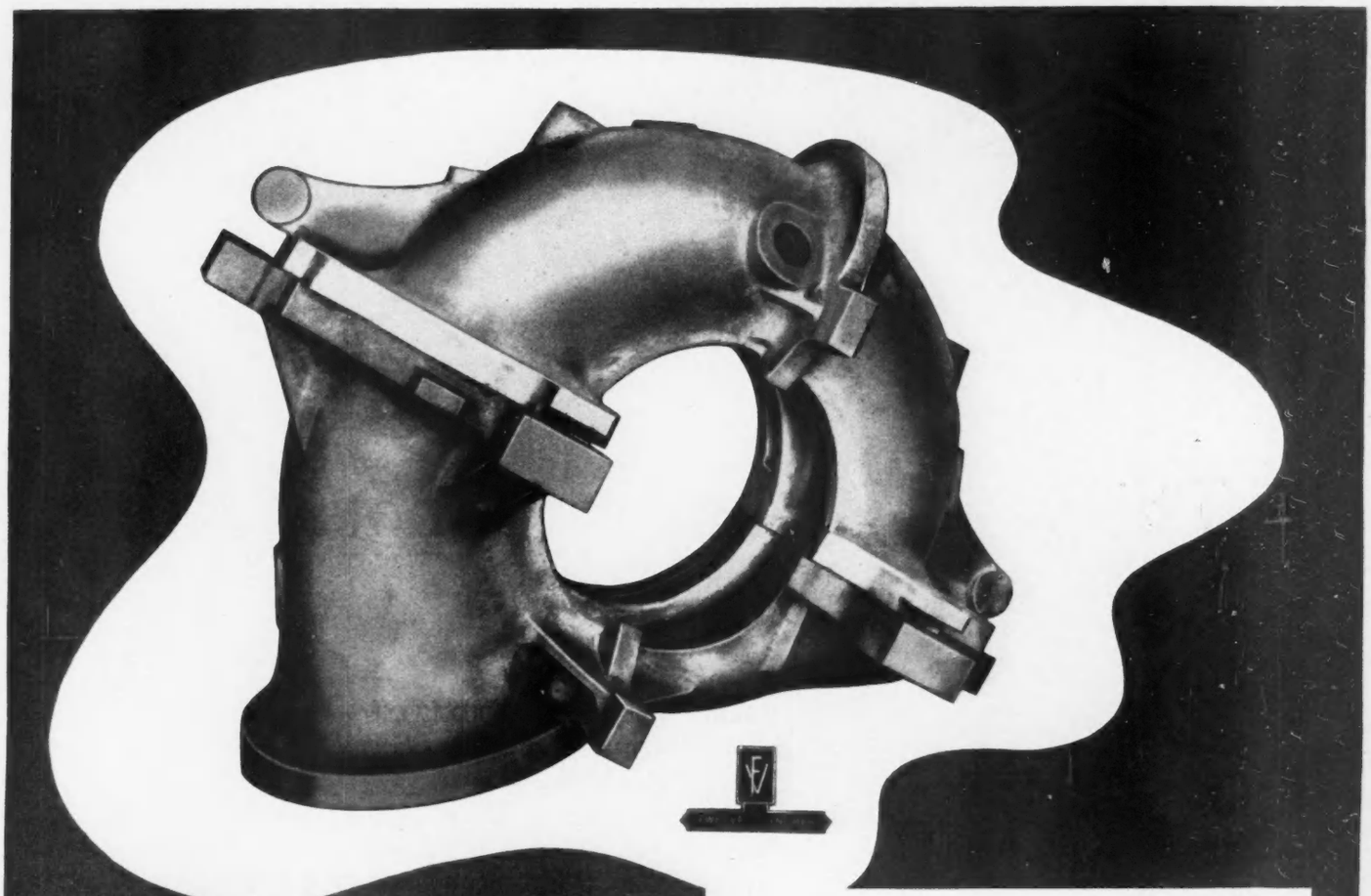
SHIPPING AND FORWARDING SERVICE...

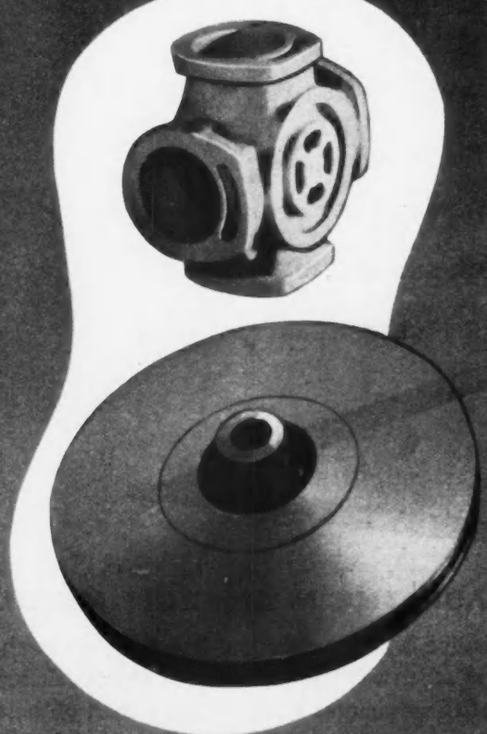
No matter how cumbersome or awkward your consignment may seem you can safely entrust it to an organization like ours which successfully handles the toughest assignment to any part of the world as a matter of normal routine

Arbuckle, Smith & COMPANY, LIMITED

91 MITCHELL STREET, GLASGOW, C.1.
Telephone: City 5050 (20 lines) *Grams:* ARBOR, GLASGOW

and at: LONDON, LIVERPOOL, SOUTHAMPTON, HULL, DUBLIN, MANCHESTER, NEWCASTLE, TORONTO, MONTREAL, WINNIPEG, VANCOUVER AND LAGOS





it's one of ours . . .

. . . and only one of the many types of stainless steel castings we produce. Sizes and weights vary from half a pound to several hundredweights. For example the Inlet casing illustrated above is 7′ 4″ across the joint faces and was cast in two parts. The total weight of both halves is 4,630 lbs.

Firth-Vickers foundries have years of experience in the special techniques necessary to produce good castings in corrosion and heat-resisting steels.

Our advice may be able to solve a probiem—so may one of our castings!

and so are these!

FIRTH-VICKERS STAINLESS STEELS LTD., SHEFFIELD

is the only company in Europe to devote its activities exclusively to the production and development of stainless and heat-resisting steels.

This... ...is a line we're not shooting!

New, dramatically improved Mobil DTE Oils give a *balanced* protection and service performance *that no other oil on the market today can equal.*

New Mobil DTE Oils for hydraulic and circulating systems have many specific advantages which, taken together, make a convincing reason for preferring them to any other oils of their kind. Here are some of the advantages you will get if you use new Mobil DTE Oils:

LONGER OIL LIFE ✓
STABILITY AT ALL TEMPERATURES ✓
FREEDOM FROM DEPOSITS ✓
PROTECTION AGAINST RUST AND CORROSION ✓
QUICK SEPARATION FROM WATER ✓
LESS WEAR ✓

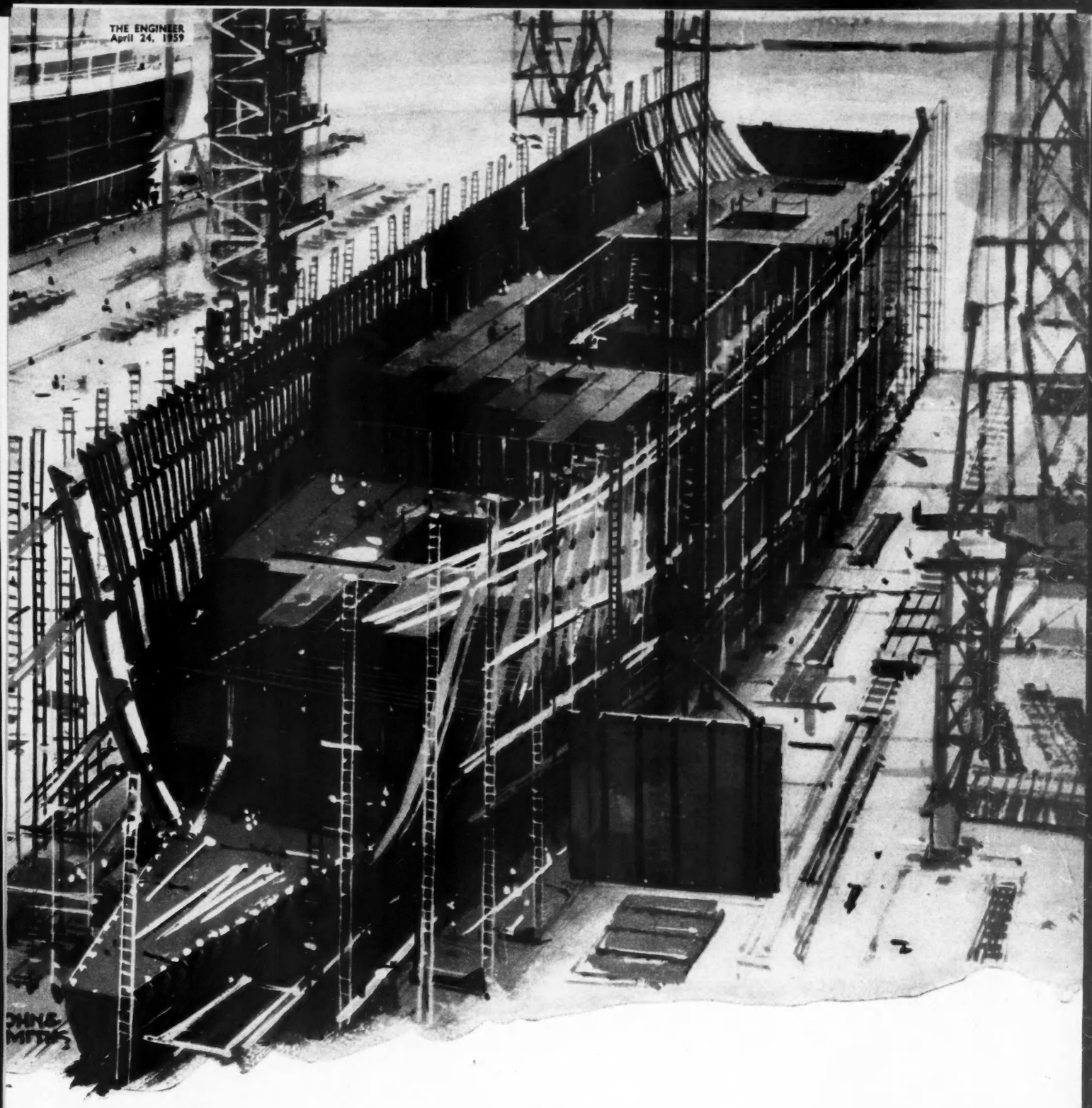
NEW balanced Mobil DTE Oils for protection and performance no other oil can equal

ASK THE MAN FROM MOBIL

This line is no exaggeration. It is the plain truth, proved in careful tests against other well known hydraulic and circulating oils. The line down our left-hand margin is taken from a chart of these tests. Ask your Mobil representative to show you the chart. He will explain how, on *balance* — on the results of all the tests — new Mobil DTE Oils show a clear advantage that can mean lower costs and improved production in your business.

Mobil

MOBIL OIL COMPANY LIMITED, LONDON S.W.1



IN SHIPYARDS, as in every sphere of industry, Metropolitan-Vickers are in the forefront of electrical progress. Many advances in the design of motors and welding machines for shipyards owe their origin to the research, enterprise and experience of this great organization.

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER 17

An A.E.I. Company

See our Stand No. E10, Grand Hall, at the Engineering, Marine, Welding and Nuclear Energy Exhibition, Olympia, April 16 - 30

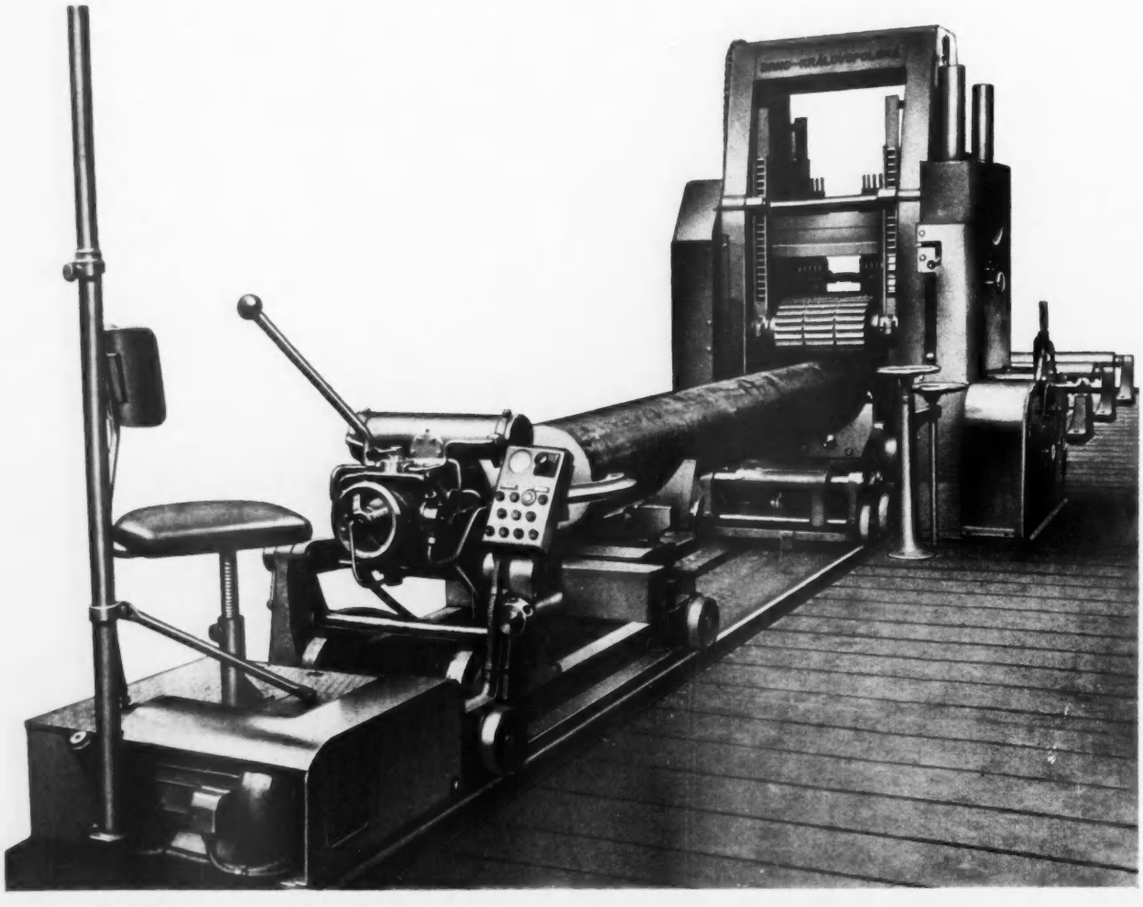
LEADING ELECTRICAL PROGRESS

A/A817

WOODWORKING MACHINES ALL OVER THE WORLD

We supply all machinery and complete equipment for sawmills, plywood and veneer plants, furniture factories, carpenters' shops and several other kinds of special woodworking machines. Czechoslovak products are exported all over the world owing to their high standard and first class workmanship.

TECHNOEXPORT PRAHA CZECHOSLOVAKIA



Cushioning in all three planes

The great success of Cushyfoot anti-vibration mountings is due to a unique combination of features.

With different degrees of flexibility in vertical, transverse and longitudinal directions, they can be arranged to give exactly the right amount of cushioning in every plane.

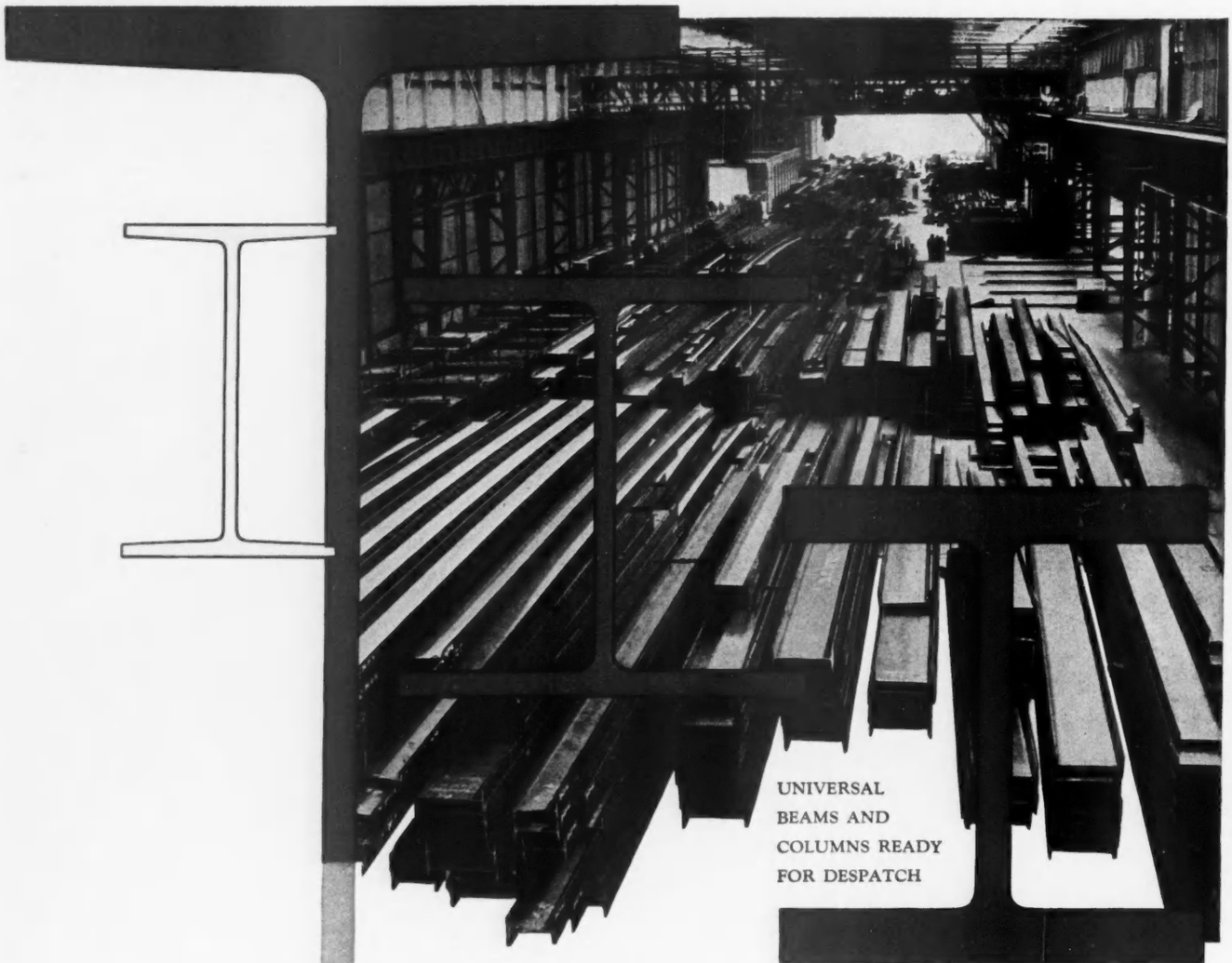
The very high deflections available isolate low frequency vibration and reduce foundation costs for large machines by obviating inertia blocks of concrete, or permitting the use of much smaller blocks. Bolting down is not necessary when friction locating pads are used in conjunction with the mountings.

For unit loads up to 3,500 lb., the Cushyfoot is compact, robust and designed so that the rubber elements never lose their resiliency and are protected from oil and mechanical damage.

Please write for brochure illustrating the application of Cushyfoot mountings to diesel generators, power presses, screens, compressors and many other machines causing vibration or requiring protection from it.

METALASTIK

METALASTIK LTD., LEICESTER



UNIVERSAL
BEAMS AND
COLUMNS READY
FOR DESPATCH

DELIVERIES FROM THE UNIVERSAL BEAM MILL

The new beam and column sections, in different weights, are now being rolled in substantial quantities and are available for early delivery.

The beams include the largest rolled in Europe. Columns are also rolled in 'families' of suitably related sections for multi-storey buildings.

The laborious riveting-on of extra flange-plates is generally unnecessary; a simple rolled section does the job better, saving steel and labour. When the limit of the plain beams is reached, the plated beams are still economical of steel.

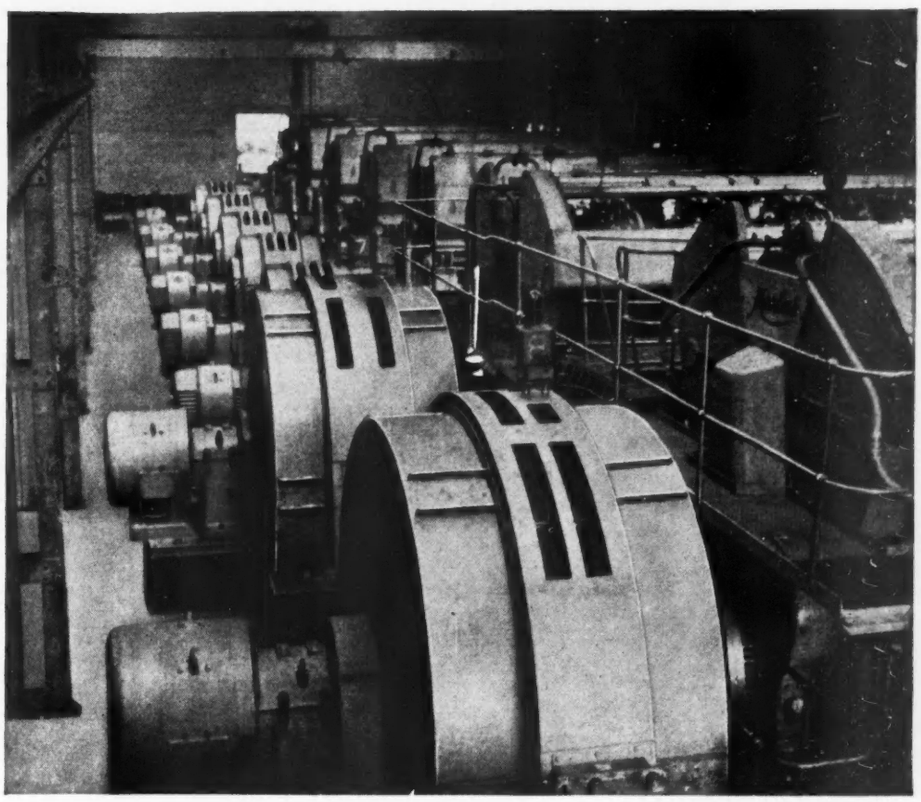
Universal beams have opened a new field for steelwork designers, offering far-reaching economies and increasing the efficiency of the structure.

DORMAN LONG

Mirrlees

DIESEL POWER FOR THE ISLE OF MAN

One of the largest diesel generating stations in Britain,
Peel Power Station, belonging to the Isle of Man Electricity Board,
provides power for the whole of the island,
with the exception of Douglas.



3 Mirrlees KVSS12 engines are installed
each developing 2880 b.h.p/2000 kW at 428 r.p.m. and
8 Mirrlees HFS8 engines developing 1320 b.h.p/920 kW at 375 r.p.m.

Mirrlees **diesels**

See the special Mirrlees exhibit on Stand No. 5, Row P.
ENGINEERING, MARINE, WELDING & NUCLEAR ENERGY EXHIBITION,
Olympia.
April 16th—30th.

MIRRLEES, BICKERTON & DAY LIMITED

A member of the Hawker Siddeley Group

HAZEL GROVE · STOCKPORT · CHESHIRE

Tel: Stepping Hill 1000 (14 lines) Grams: "Mirrlees, Telex, Manchester"

IE20

F

43 Special Steel Grades

have been developed by us in the course of decades in close cooperation with the works of the chemical industry.

Our SICROMAL and RHEINROHR special steels show all the properties required of high standard steel grades; they are non-scaling and non-magnetic, with high temperature stability, inert nature of surface and ductile at sub-zero temperatures, resistent to acids, corrosion, caustics, high pressure hydrogen etc.

PHOENIX-RHEINROHR AG

VEREINIGTE HUTTEN- UND ROHRENWERKE DUSSELDORF - GERMANY

From the LARGEST

HEXAGON, BIHEXAGON, SQUARE & BISQUARE FOR HAND, POWER & IMPACT. ENGLISH, AMERICAN, UNIFIED & METRIC SIZES. ¼", ⅜", ½", ¾", ⅞", 1" & 1" SQUARE & .448" Hexagon drives. Nut sizes .152" to 3.150" across flats.

TO THE smallest

EXCLUSIVE Features – Made from Chrome Alloy Steel, Hot forged, Dimensional accuracy, Uniformity of shape, Maximum strength & life, Full nut clearance, Cleanest possible internal formation, Small outside diameters.

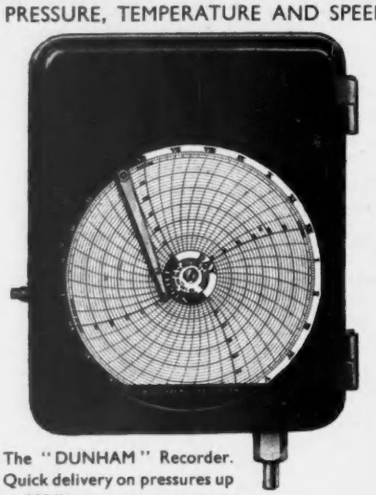
TOOL UP WITH CHROME ALLOY STEEL BRITOOL SERVICE TOOLS

Manufactured at
BRITOOL WORKS, BUSHBURY, WOLVERHAMPTON, ENGLAND.

Budenberg

RECORDERS

FOR PRESSURE, TEMPERATURE AND SPEED



The "DUNHAM" Recorder. Quick delivery on pressures up to 300 lb per sq. in. or vacuum with 24 hour record and spring clock.

BUDENBERG GAUGE CO. LTD.,

BROADHEATH, Nr. MANCHESTER

Tel: ALTrincham 2617 (3 lines)
Regency House, 1-4 Warwick St., London, W.1. Phone: GERrard 4822-3. Grams: Pyrometer, Piccy, London
62 Robertson Street, Glasgow, C.2. dm BU. 35

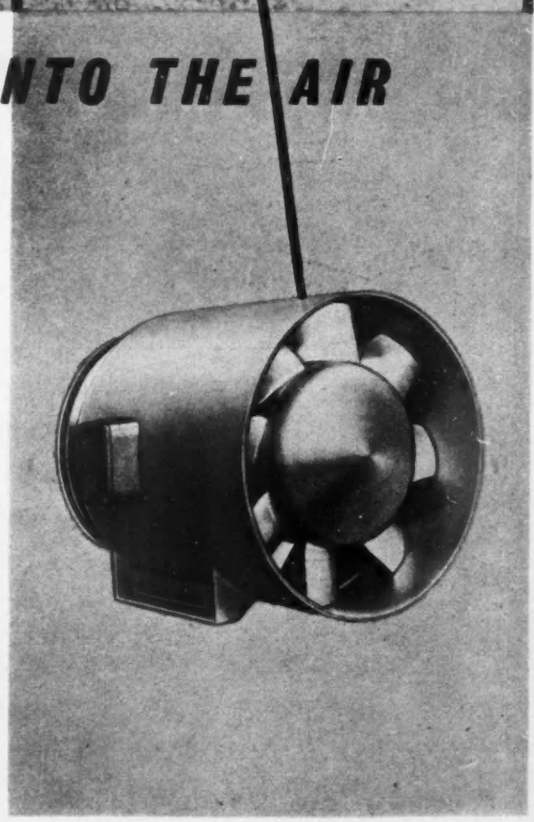
Crown copyright reserved, reproduced by permission of the Controller, H.M. Stationery Office

GETTING BLOODHOUND INTO THE AIR

For the launching gear of the Bristol/Ferranti Bloodhound a 15″ diameter high pressure axial cooling fan was developed specially by Air Control Installations Ltd.

Once again Air Control products have proved that they measure up to the most stringent specifications. And it is reassuring to know that a firm like Air Control make a very wide range of air treatment plant and equipment for numerous applications.

From the Air Control range you can select the equipment best suited to your needs. . . air filters, air conditioners, dust and fume control plant, fume extraction plant. . . plus the greatest range of industrial fans available.



AIR CONTROL

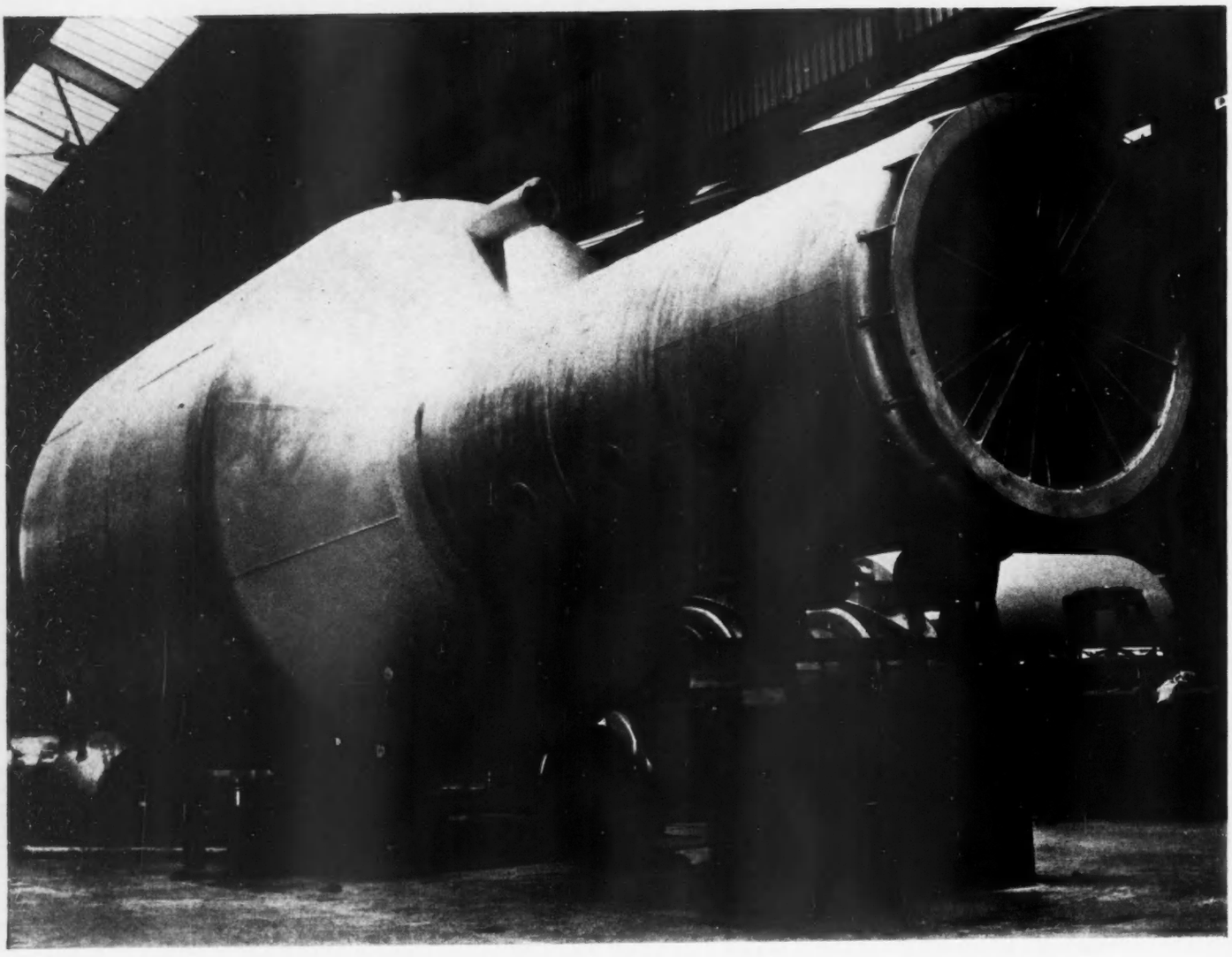
INSTALLATIONS LIMITED

RUISLIP · MIDDLESEX · RUISLIP 4066

LONDON · BIRMINGHAM · MANCHESTER · NEWCASTLE · GLASGOW

We are on Stand 27, Outer Row, Grand Hall Gallery at the Engineering, Marine, Welding & Nuclear Energy Exhibition, Olympia—April 16-30

FILTERS · DUST COLLECTORS · AIR CONDITIONERS · FANS · FILTERS · DUST COLLECTORS · AIR CONDITIONERS · FANS · FILTERS · DUST



Visit the Great

ENGINEERING
MARINE
WELDING
& NUCLEAR
ENERGY
EXHIBITION

OLYMPIA LONDON
16th–30th APRIL 1959

STAND 1 ROW CC
Empire Hall, First Floor

BRITISH ALUMINIUM

for MERLIN REACTOR

This Core Tank for a Merlin-type Swimming Pool Reactor was produced by The A.P.V. Co. Ltd, using BA 99.5% purity aluminium plate, inert-gas welded.

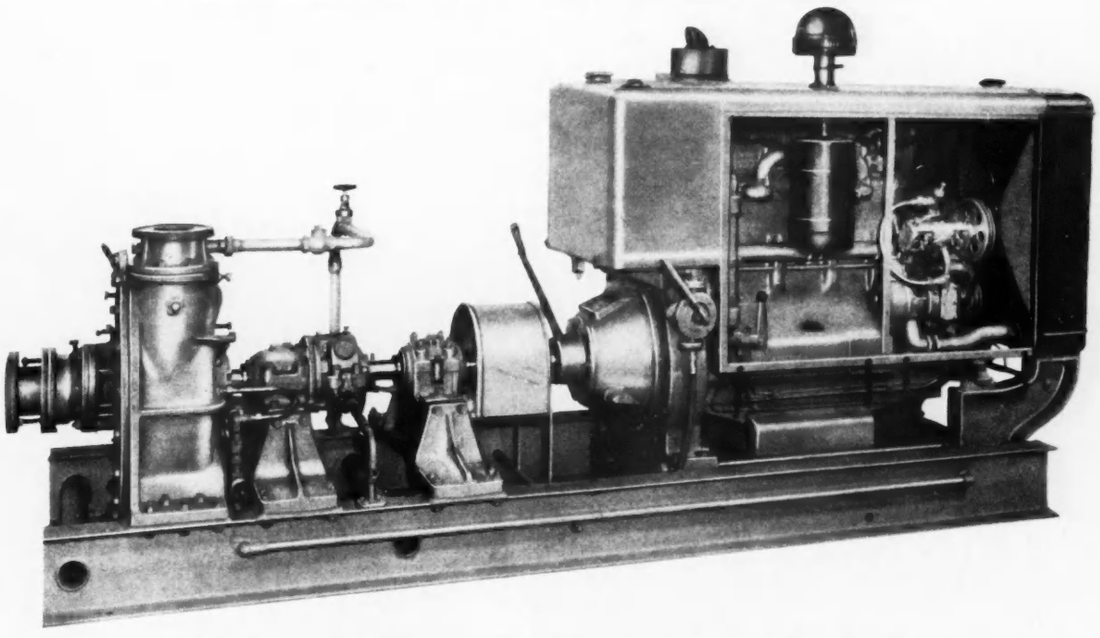
In many and often unpublished ways British Aluminium provides technical assistance and material to the Nuclear Energy Industry.

The BRITISH ALUMINIUM Co Ltd

NORFOLK HOUSE ST JAMES'S SQUARE LONDON SW1

AT 333

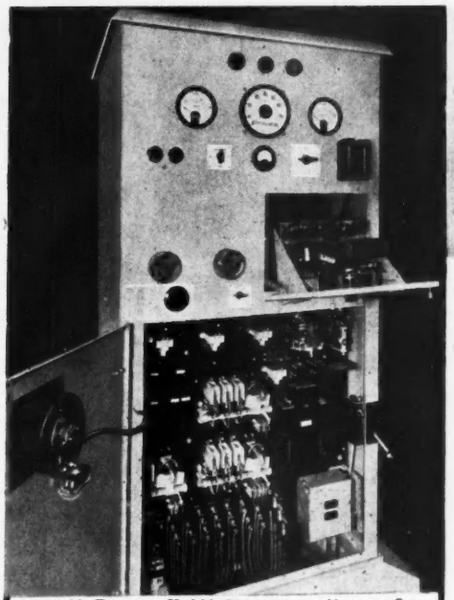
GRAVEL PUMPS



4½/5" Centrifugal Sand and Gravel Pump with Diesel Engine Drive.

EASTON & JOHNSON LTD. · TAUNTON, ENGLAND

TELEPHONE 3146 **GRAMS: EASTWALD, TAUNTON**



Variable Frequency Variable Voltage motor Alternator Set. Control Panel illustration shows Electronic Servo Regulator withdrawn for inspection.

Input	400 volts 50 cycles 3 phase
Output	10 kVA single phase
Voltage range	100/250 controlled ± 3%
Frequency range	65/25 cycles stabilized electronically within ± 0·5% of set value

universal power plant

An "Electro-Dynamic" Power Plant has been installed for Powers-Samas Accounting Machines Ltd., to provide the wide range of voltages and frequencies required to reproduce those obtained in any part of the world to which their machines may be supplied; E.D.C.C. supply all types of test equipment, including Dynamometers and Automatic Control Gear for all applications. E.D.C.C. Technical Staff are always available for consultation on customers' special problems.

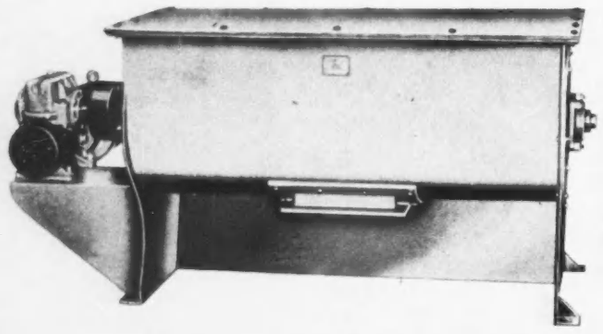
Photographs by courtesy of Powers-Samas Ltd.

ELECTRO-DYNAMIC CONSTRUCTION CO LTD

ST. MARY CRAY, KENT Telephone: ORPINGTON 27551 Telegrams: Eledamic St. Mary Cray

Control Gear Division
BRIDGWATER, SOMERSET
Telephone: Bridgwater 2882

Glasgow Office
40 HOULDSWORTH ST., C3
Telephone: Central 2620



HORIZONTAL MIXER

THIS MODERN HORIZONTAL MIXER GIVES THE MOST ACCURATE PREMIX OF SUPPLEMENTS AND FEED STUFFS
AVAILABLE FROM LABORATORY SIZES UP TO 3 TONS CAPACITY

W. S. BARRON & SON LTD.
GLOUCESTER

Manufacturers with over 50 Years' experience — Offer the latest in
CRUSHING · GRINDING · MIXING
FEEDING · SIEVING
MACHINERY

TWIN OR MULTIPLE WORM BIN DISCHARGER

TAPERED OR VARIABLE PITCH WORMS DRIVEN BY AN ELECTRIC MOTOR TO REGULATE THE FLOW OF MATERIAL FROM STORAGE BINS.
SIZES TO SUIT ANY LAYOUT.

Phone: Gloucester 21055/6/7. *Cable: BARRON Gloucester.*

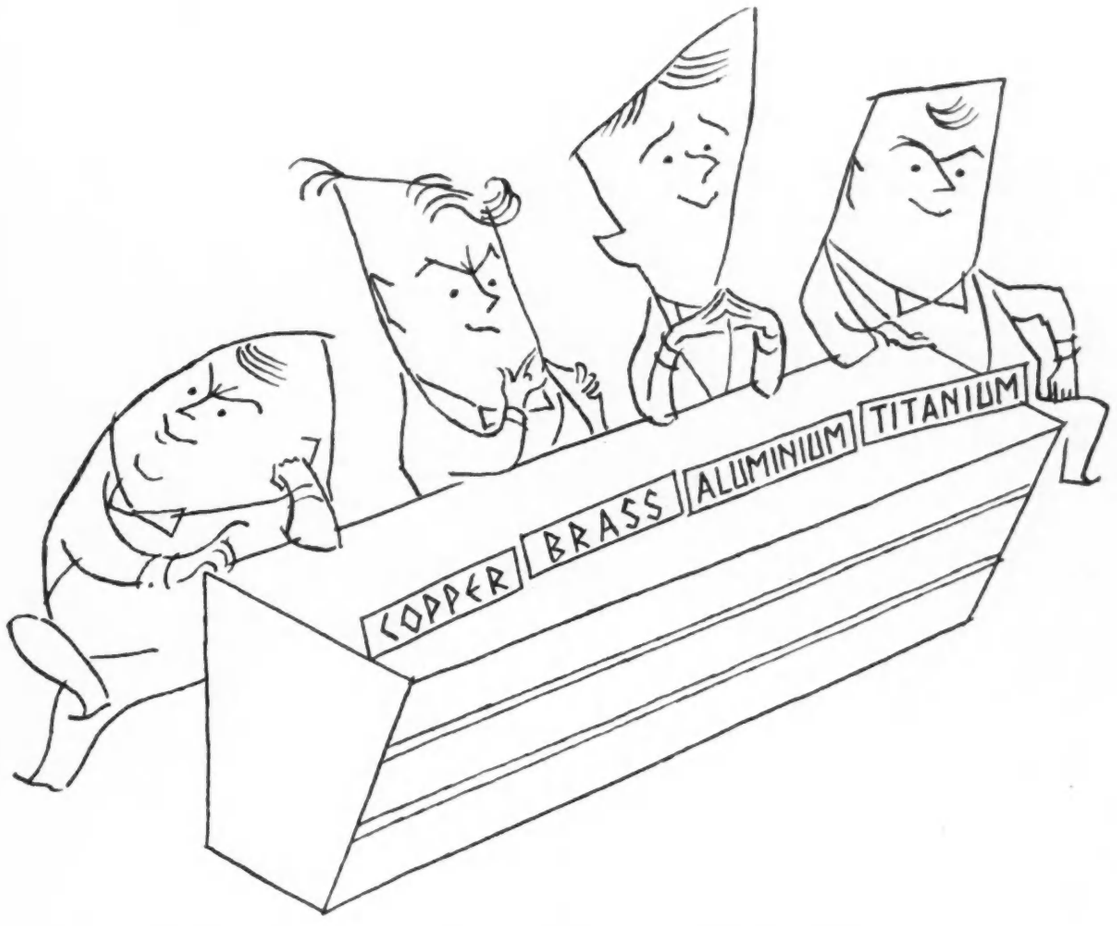
The DeVlieg method effected savings of— 26% in machining time and 69% in setting time

The older method using a Horizontal Boring Machine required eight set-ups, but with the DeVlieg Jigmil only two were required.
Operations vary from precision boring a hole 1·251in. dia. by 6½in. long to milling the joint faces: in all, sixty-six operations are performed.
The Jigmil method also considerably reduces the number of boring bars and miscellaneous equipment normally required for each operation on a horizontal boring machine.

The smallest of the range of DeVlieg Spiramatic Jigmils, known as the Herbert DeVlieg No. 2B 36 is now built by us in a specially-equipped plant at Lutterworth. The 2B 36 has vertical and horizontal capacities of 24in. and 36in. respectively ; a 2½in. dia. spindle.

ALFRED HERBERT LTD., COVENTRY

AD 389



A team you can trust

Don't leave anything to chance when you're ordering copper, brass, aluminium or titanium. Go straight to the experts — go immediately to I.C.I. Metals Division.

They will give you the benefit of years of experience and intensive research, exceptional production facilities, a nation-wide sales organisation and considerable specialist talent. More than likely they'll be full of suggestions for dealing with your special problem. If not, they'll be eager to meet the new challenge and find the exact answer. This is how I.C.I. Metals Division has built up its versatile and supremely trustworthy team. For you, it could well mean time and effort saved and a difficult job perfectly completed

Specialists in

Copper • Brass • Aluminium • Titanium

Information and literature are available from the sales offices in Belfast, Birmingham, Bradford, Bristol, Dublin, Glasgow, London, Manchester & Newcastle-on-Tyne

ICI **METALS DIVISION**

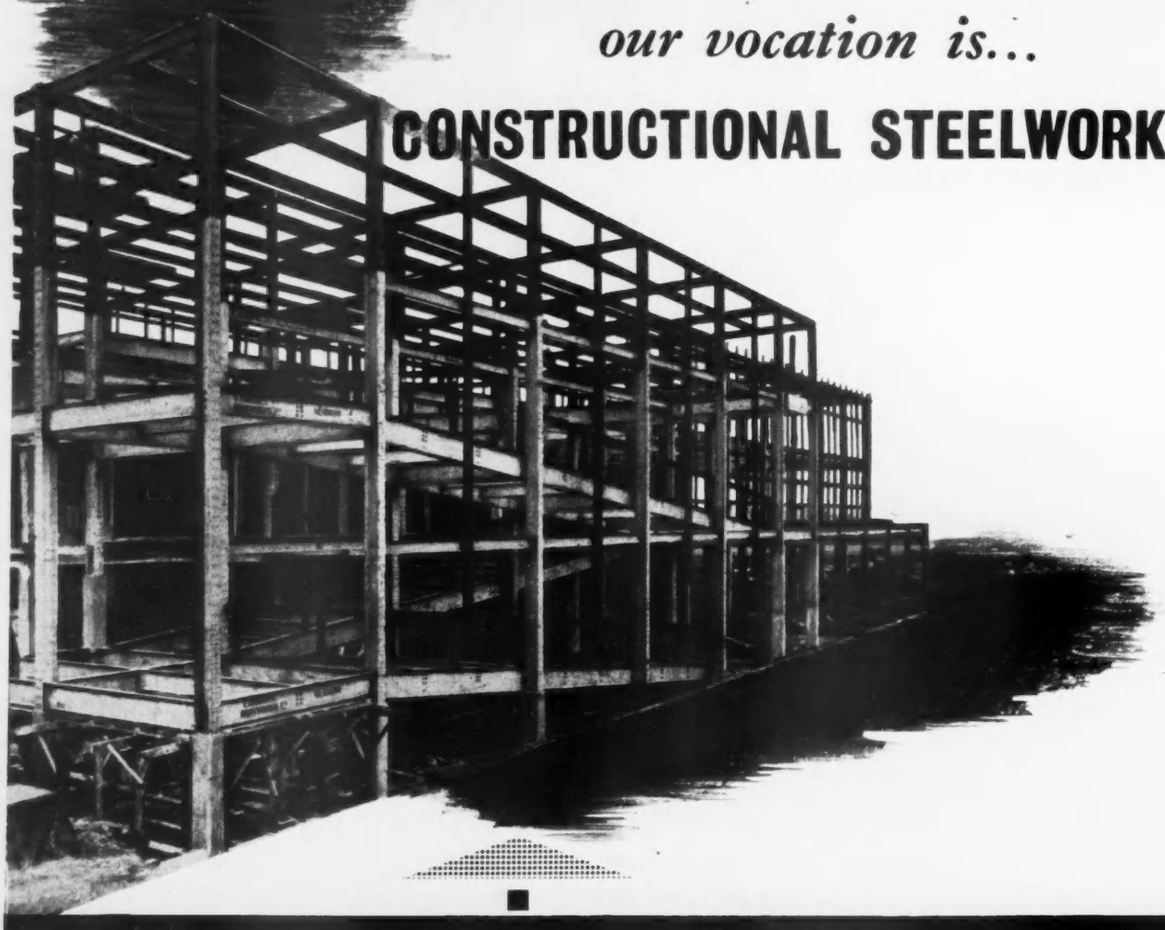
IMPERIAL CHEMICAL INDUSTRIES LIMITED LONDON S.W.1

M.27

OUR MEDIUM IS **STEEL**

our vocation is...

CONSTRUCTIONAL STEELWORK



LAMBHILL IRONWORKS
LIMITED
GLASGOW, N.2
'Phone: POSSIL 8386-7-8. 'Grams: "ERECTIONS" GLASGOW

From drawing board to finished framework we place a wealth of specialised knowledge and practical experience at your command. Modern plant and methods exactly co-ordinated to the purpose of the job ensure the utmost economy consistent with trustworthy achievement. " Steelwork from Lambhill " is your guarantee of steadfast, intelligent workmanship exactly applied to your requirements with speed and efficiency.

ALSO AT: LONDON · NEWCASTLE · SHEFFIELD

Thornton

BOGIE for 30 ton Capacity Electric Furnace Charging Basket

Designed to transport a 30 ton capacity Electric Furnace Charging Basket. Total weight of Basket and contents 43 tons. Frame fabricated from Mild Steel and arranged with Controls, Handbrake, Battery, Headlights and Rear Lights at each end with Electric Hooter for continuous sounding immediately power is applied. Reversible and powered by two 15 H.P. Motors direct coupled to axles through totally enclosed Worm Reduction Units. Speed of Car 3.1 m.p.h. Wheels arranged for 4′ 8½″ rail gauge and axles rotate in Roller Bearing Axle Boxes. Constructed and painted to comply with Safety Regulations in Steel Works.

CONSULT US

for the design and manufacture of medium and heavy engineering equipment for all steel works plant including Rolling Mills and their auxiliaries, all types of Ingot and Transfer Cars, Gas Works and Chemical Plant, Heavy fabrications and Pressure Vessels.

B. THORNTON LTD.

TURNBRIDGE HUDDERSFIELD

Phone: Huddersfield 7541

The jib for the job!

MORRIS

DIESEL-ELECTRIC

MOBILE CRANES

have the reach required!

Whether you want to lift up to 60 feet or up to a mere 15 feet, Morris mobile cranes can be supplied to provide the " reach " required, since the Morris range includes both the length and type of jib for most jobs.

Basically, the essential features of the crane chassis and superstructure remain the same irrespective of the length of the jib or whether it is of the strut type (as illustrated) or the cantilever type.

These features may be summarized as follows :—

Centrally mounted superstructure giving an equal radius clearance and stability when handling loads over the front or back of the crane.

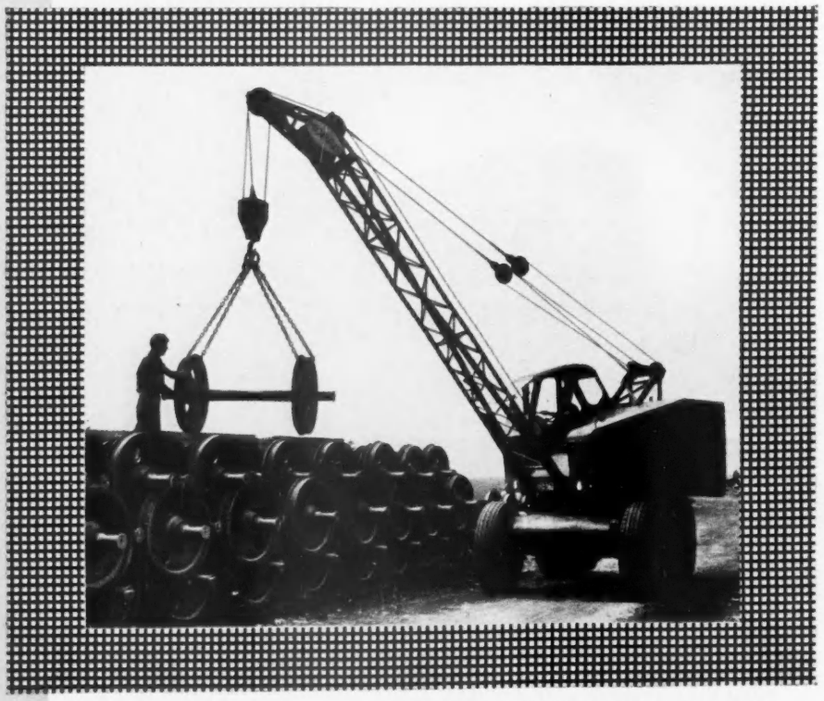
Easy control with no heavy levers to operate—just a finger touch controls all motions.

Flange mounted motors ensuring perfect and permanent alignment. All main assemblies are of unit construction.

Four-speed gearbox allows fast or slow travel according to the load being handled.

Hydro-mechanical brakes on all road wheels.

Fully interchangeable wheels, including tyres, rims, brakes and hubs. These components are interchangeable on all four road wheels of equal size.

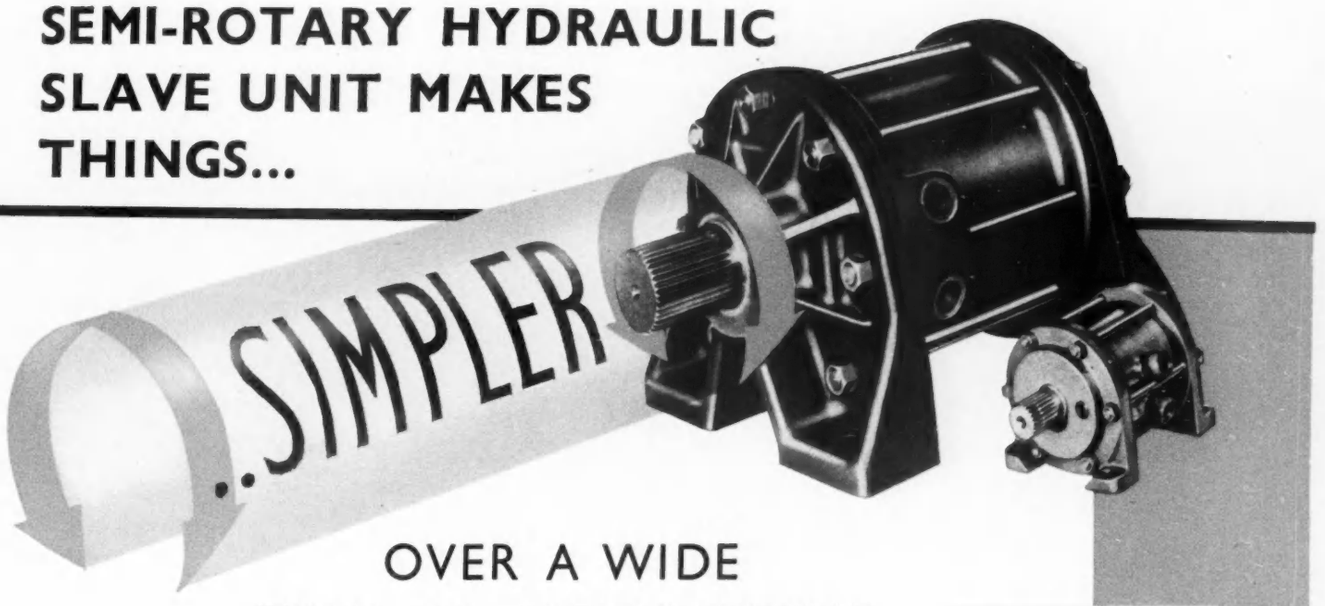


By Courtesy of CAMBRIAN WAGGON & ENG. Co Ltd. CARDIFF

HERBERT MORRIS LTD P.O. Box 7 LOUGHBOROUGH ENGLAND

TELEPHONE : LOUGHBOROUGH 3123

SEMI-ROTARY HYDRAULIC SLAVE UNIT MAKES THINGS...



OVER A WIDE FIELD OF APPLICATIONS

THESE double-acting units give semi-rotary motion up to 300° for single vane and up to 120° for double vane units with torques ranging from 1,270 to 1,100,000 lb/ins. at 1,000 p.s.i. Autoloc mechanical locking can be incorporated and shafts may project at either or both ends. Units can be arranged for foot or flange mounting. Normal maximum operating speed is 2 radians per second.

They have wide application in any field in which oscillatory angular motion is required and are particularly appropriate for the operation of plug valves, vanes, doors, stirring or agitating equipment, sand slingers, etc.

This is just one group of a wide range of Lockheed hydraulic units of which full details will be sent on request. Lockheed engineers are always ready to advise upon the use of units, devise schemes of hydraulic operation and control and install complete hydraulic systems.

Dampers

The Lockheed rotary unit can be coupled direct to the damper spindle, its housing flange-mounted to the damper casing, so that the bearings of the unit also support one side of the damper.

Linkage

Where angular movement is needed, direct coupling is often possible. When the angular movement is considerably less than that of the Lockheed unit, unequal linkage can enable a small unit to be used to give the required effort.

Clamps & Jigs

The angular movement of the Lockheed unit lends itself to extremely simple clamping and jigging.

LOCKHEED PRECISION PRODUCTS LIMITED
INDUSTRIAL HYDRAULICS DIVISION
SHAW ROAD, SPEKE, LIVERPOOL 24 *Telephone: HUNTS CROSS 2121*

Lockheed

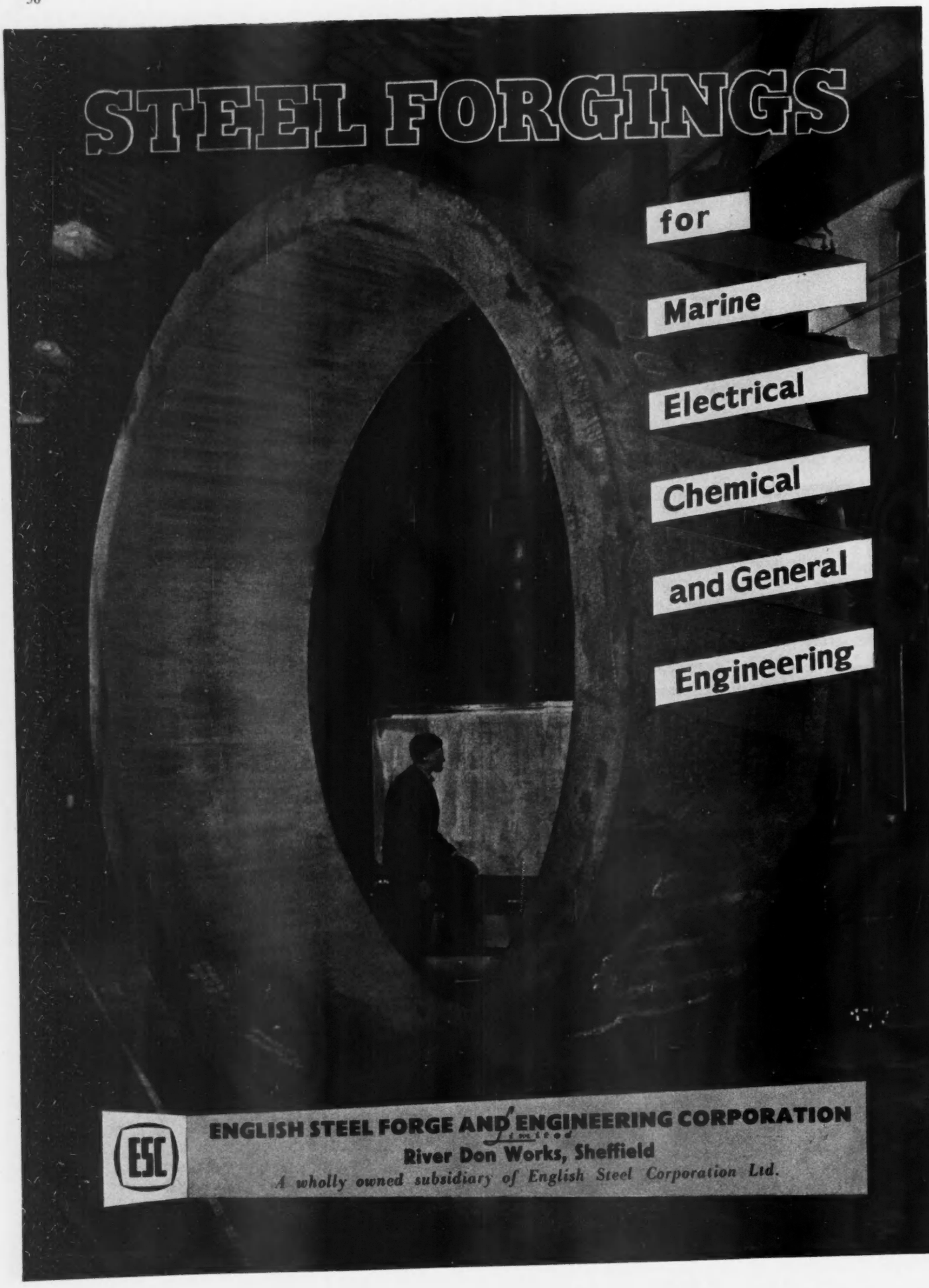
REGD TRADE MARK

INDUSTRIAL HYDRAULICS

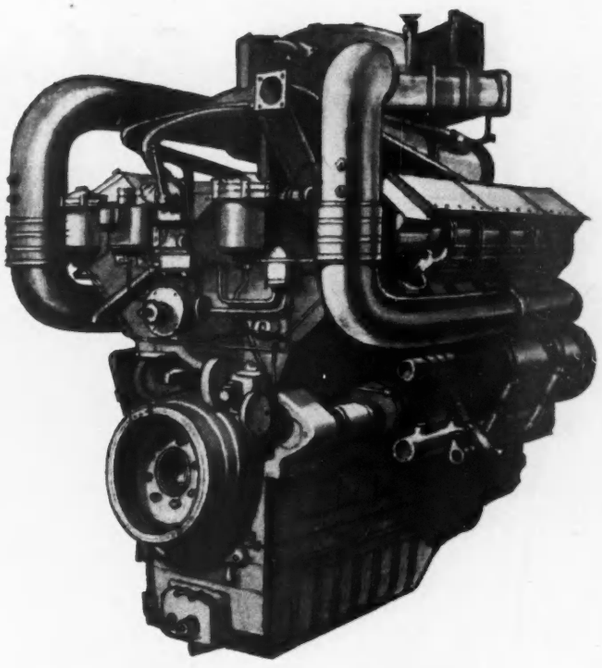
COMPLETE INSTALLATIONS BRITISH MADE OR INDIVIDUAL UNITS

(One of the Automotive Products Associated Group of Companies)

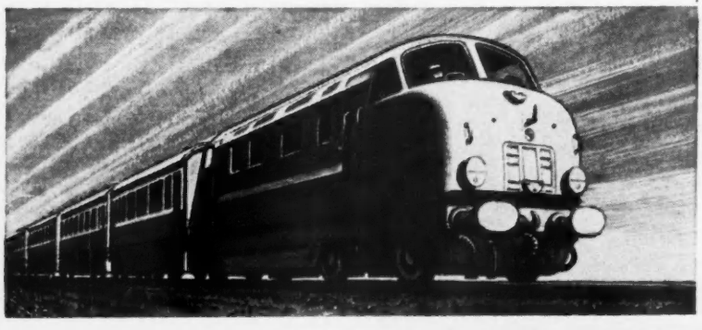
Visit us at **The Engineering, Marine, Welding and Nuclear Energy Exhibition**
STAND 4 *Ground Floor, Grand Hall* **STAND 8** *Inner Row Gallery, National Hall*


STEEL FORGINGS
for
Marine
Electrical
Chemical
and General
Engineering
ESC
ENGLISH STEEL FORGE AND ENGINEERING CORPORATION
Limited
River Don Works, Sheffield
A wholly owned subsidiary of English Steel Corporation Ltd.

MAYBACH POWER MADE IN BRITAIN

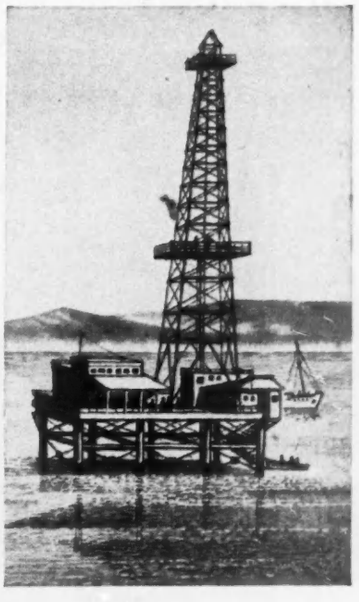


Typical of the MD range of engines is this Type 650 12 cylinder supercharged model with cylindersarrangedin'V'formation.

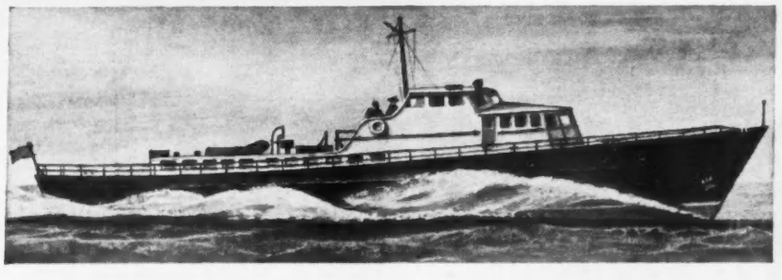


Railway Traction 220-2,000 B.H.P.

Industrial Plant 220-1,750 B.H.P.



Marine 220-3,000 B.H.P.



Bristol Siddeley have the exclusive manufacturing and selling licence in the United Kingdom for the world-famous Maybach MD range of In-line and 'V' form diesel engines. These diesels range from 4-cylinder engines of 220 hp to 16-cylinder engines of 3,000 hp. They have an outstanding record of performance and reliability over millions of miles on railways throughout the world, and are widely used for marine propulsion and industrial power generation of all kinds.

BRISTOL SIDDELEY

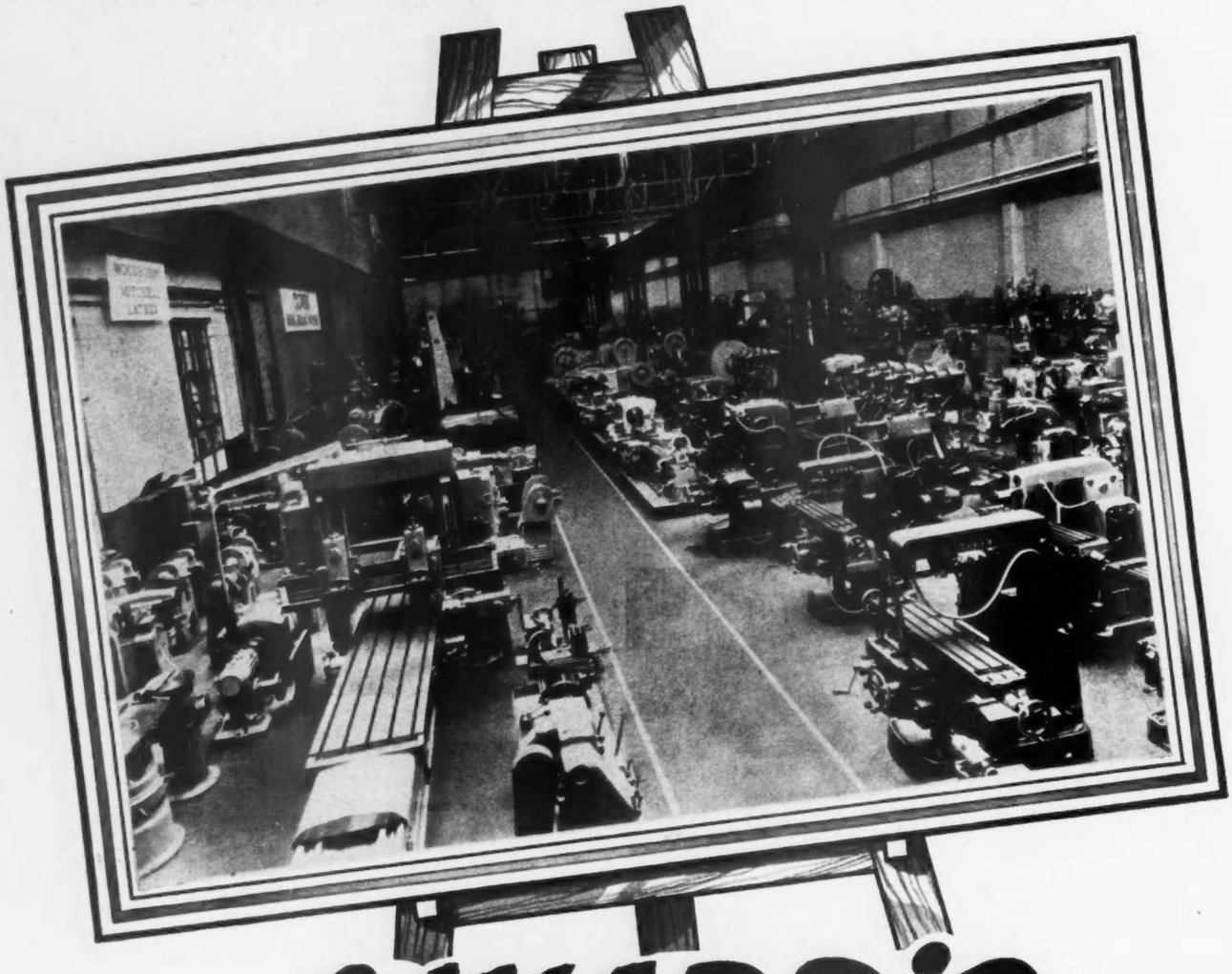
Maybach

DIESEL ENGINES

BRISTOL SIDDELEY ENGINES LIMITED

Coventry, England

An Exhibition in itself....



one of WARD'S MACHINERY SHOWROOMS AT SHEFFIELD

Others at : SILVERTOWN (LONDON) · GLASGOW · BRITON FERRY

VISITORS ARE ALWAYS WELCOME AND REMEMBER—WARDS MIGHT HAVE IT!

THOS. W. WARD LTD

ALBION WORKS · SHEFFIELD
'PHONE 26311 (22 lines). 'GRAMS 'FORWARD SHEFFIELD'
LONDON OFFICE: BRETTENHAM HOUSE
LANCASTER PL. STRAND W.C.2, 'PHONE TEM 1515

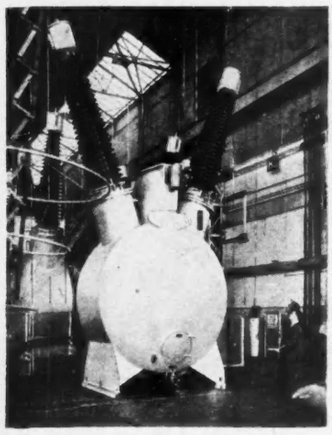
G.56

KARIBA at 330 kV.

All the bushing porcelains for
the 330 kV. circuit breakers
All the 330 kV. strain insulators
for the substations
and the 330 kV. post insulators
for some of the substations by

BULLERS

MAIN CONTRACTORS · B.T.H. Co. Ltd.
Consulting Engineers · Merz & McLellan



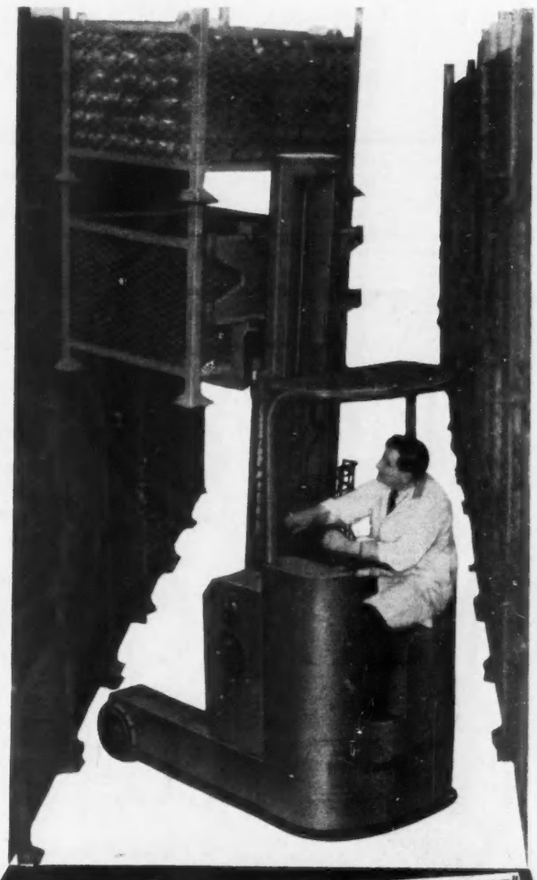
The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the B.T.H. Co.

BULLERS LIMITED · MILTON · STOKE-ON-TRENT · STAFFS
Telephone: Stoke-on-Trent 54321
London: 6 Laurence Pountney Hill, E.C.4. Tel.: MANsion House 9971

HUNT

Gilled Tubes & Heaters
HUNT & MOSCROP LIMITED
P. O. Box No. 8 MIDDLETON · MANCHESTER

Model FRER 245 now in series production.



"WITH COMFORT"
2 ton loads in 90" gangways

NO OTHER TRUCK OFFERS SO MANY ADVANTAGES

WRITE FOR DETAILED SPECIFICATION TO DEPT. 11.

Lansing Bagnall

LANSING BAGNALL LTD.
BASINGSTOKE · HAMPSHIRE · ENGLAND
Tel: Basingstoke 1010. Telegrams: Bagnallic, Basingstoke.
Also at: BIRMINGHAM, CARDIFF, WARRINGTON, GLASGOW, LONDON, TORONTO and ZURICH

complexity

—simplicity→

... but each executed with the same precision vital to high grade chemical engineering plant and which can always be found in work carried out by Burnett and Rolfe Limited.

DESIGN AND CONSTRUCTION TO BRITISH, AMERICAN CODES AND LLOYD'S

BURNETT & ROLFE LIMITED
THE ESPLANADE · ROCHESTER · KENT.
Tel: CHATHAM 41766
NORTHERN OFFICE: 32 Deansgate, Manchester. Tel: Blackfriars 9084

NOTHING GETS PAST Hallprene

Hallprene

PATENT FLUID SEALS

PATENT No. 734525
U.S.A. PATENT No. 2,755,118
CANADIAN PATENT No. 547268

High pressure sealing over long periods is ensured by Hallprene Patent Fluid Seals. These seals overcome certain disadvantages of normal "U" type packing rings. Handling damage and inward collapse of the sealing lips is prevented by a soft, pliable synthetic rubber filling. Under pressure, this filling forces out the walls, ensuring a perfect seal.

Hallprene Patent Fluid seals are impervious to the action of hydraulic fluids.

HALL & HALL LTD

OLDFIELD WORKS HAMPTON MIDDLESEX . Tel: Molesey 2180 (8 lines)
IN SCOTLAND:—
WILSON PLACE EAST KILBRIDE GLASGOW · Telephone: East Kilbride 20581
P329

The STEEL CONSTRUCTION CO. LTD.

Whitegates Engineering Works
MOTHERWELL · SCOTLAND
Telegrams: "DEVISERS, WISHAW" Telephone: WISHAW 289 & 290

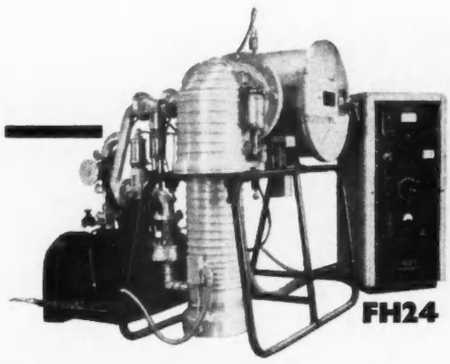
Contractors to the Admiralty, War Office, Air Ministry and H.M. Office of Works

LONDON OFFICE: LONG LANE, HILLINGDON, MIDDLESEX.
Telephone: UXBRIDGE 3925

All Classes of STRUCTURAL STEEL WORK

PLATED TUBE WORK

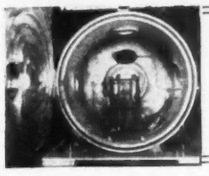
Riveted or Welded



HIGH VACUUM FURNACE UNIT

The FH 24 High Vacuum Furnace is designed for small capacity melting or sintering, using induction or resistance heating. It can be supplied with tilting crucible and fitted with heated or cooled moulds as required. The standard range of the VIA-VAC furnaces provides for capacities from ½ lb. to 3,000 lbs. melting and casting in the vacuum.

Metal degassing plant up to a capacity of 15 tons can also be supplied.



FH 24S.

A SINTERING VERSION FOR METALS OR FOR SPECIAL APPLICATIONS WHERE BOTTOM POURING IS REQUIRED

HIGH VACUUM CONSULTING
VIA-VAC
SERVICE TO INDUSTRY

VACUUM INDUSTRIAL APPLICATIONS LIMITED

DEPT. E., WISHAW, LANARKSHIRE, SCOTLAND

Telegrams: "VIA-VAC, WISHAW" *Telephone: WISHAW 142*

THERMAL ELEMENTS.

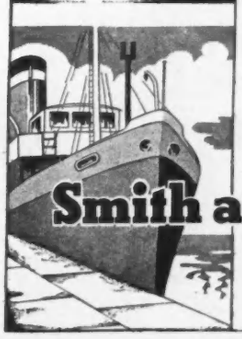
Invite your enquiries for:—

ELECTRIC ELEMENTS

- INDUSTRIAL TUBE HEATERS
- FRAME HEATERS
- CERAMIC ROD HEATERS
- RESISTANCES
- CERAMICS

RING-UPLANDS 5285.

STATION WORKS
WHYTELEAFE-SURREY.



Serving Britains Industry

GRIFFIN BRAND

STEEL SHEETS

Light and Heavy Industry are served by Griffin Brand Steel Sheets—Black, Galvanised, Flat and Corrugated.

We make the widest steel sheets and have the largest general galvanising plant in Great Britain.

Metal Spraying by the most up-to-date methods done in our works or 'in situ'.

Metals deposited include: Zinc, Tin, Aluminium, Copper and all its alloys, Cadmium, Monel Metal, etc.

Smith and McLean Ltd.

179 WEST GEORGE STREET
GLASGOW, C.2.

Tel: CENtral 0442. 'Grams: "CIVILITY Glasgow."

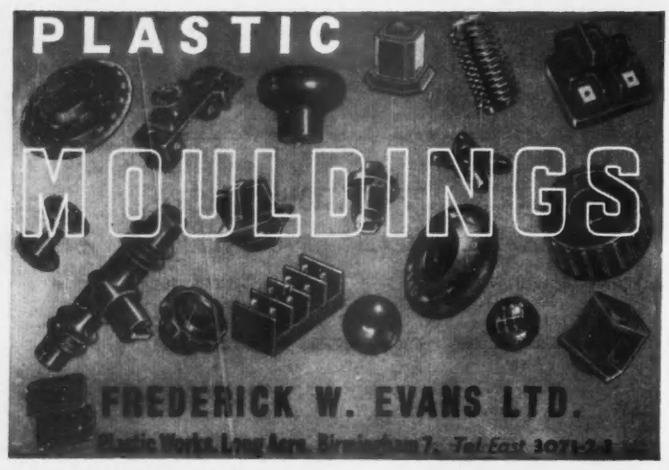
STEEL FRAME BUILDINGS
OF EVERY DESCRIPTION

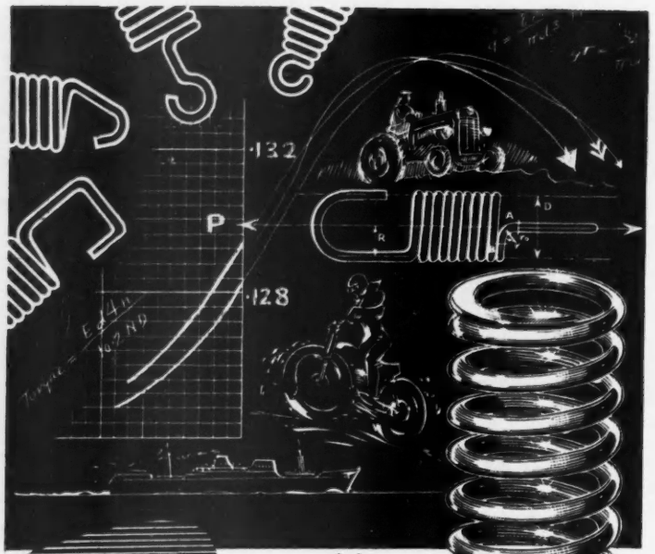
Factories, Sheds, Mill Buildings, Bungalows, Etc. Etc.,

SPECIALITIES: Pit Headgear, Pumping Stations, Power Stations

Bridgework and Riveted Work of all descriptions

BROWNLIE & MURRAY LTD.
POSSIL IRONWORKS, POSSIL PARK, GLASGOW
LONDOM: 32 QUEEN VICTORIA ST., E.C.4

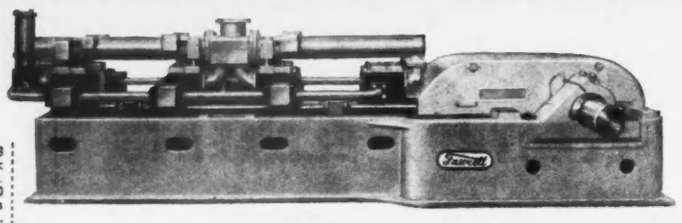




Ratcliffe
SPRINGS
F. S. RATCLIFFE (ROCHDALE) LIMITED,
CRAWFORD SPRING WORKS, NORMAN ROAD, ROCHDALE
'Phone: Rochdale 4692 3. 'Grams: Recoil, Rochdale. CW5188

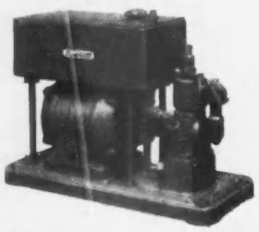
Fawcett
Hydraulic Pumps for all Industrial Applications

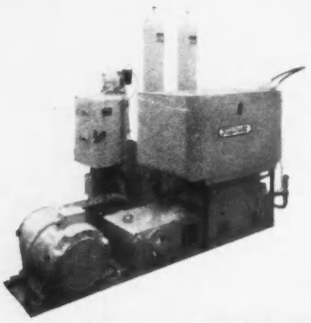
constant and variable pressures



Horizontal 4, 6 or 8 plunger type hydraulic pump for water. Speeds up to 300 r.p.m. and pressures up to 6,000 p.s.i.

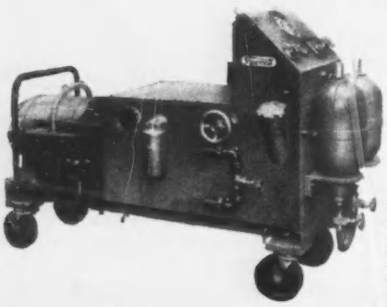
"S" TYPE PUMP OF THE RECIPROCATING TYPE. Capacity 65 cubic inches per minute at 5,600 lbs. per square inch. Variable pressure control. 1 H.P. ELECTRIC MOTOR AT 1,440 R.P.M. Also VALVES TO SUIT ALL REQUIREMENTS.





Horizontal 4 ram pump for water with central power unit embodying two 8 gallon Greer-Mercier hydro-pneumatic accumulators. Working pressures up to 5,000 p.s.i.

Fawcett high pressure pumps for oil and water are made for constant and variable pressures with volumes from ¼ g.p.m. up to 200 g.p.m. and may be supplied complete with Greer-Mercier Hydro-pneumatic Accumulator stations to meet *your* particular requirements. We will gladly supply further details on any of the types of pumps illustrated and be pleased to advise on units designed to your needs and specifications.

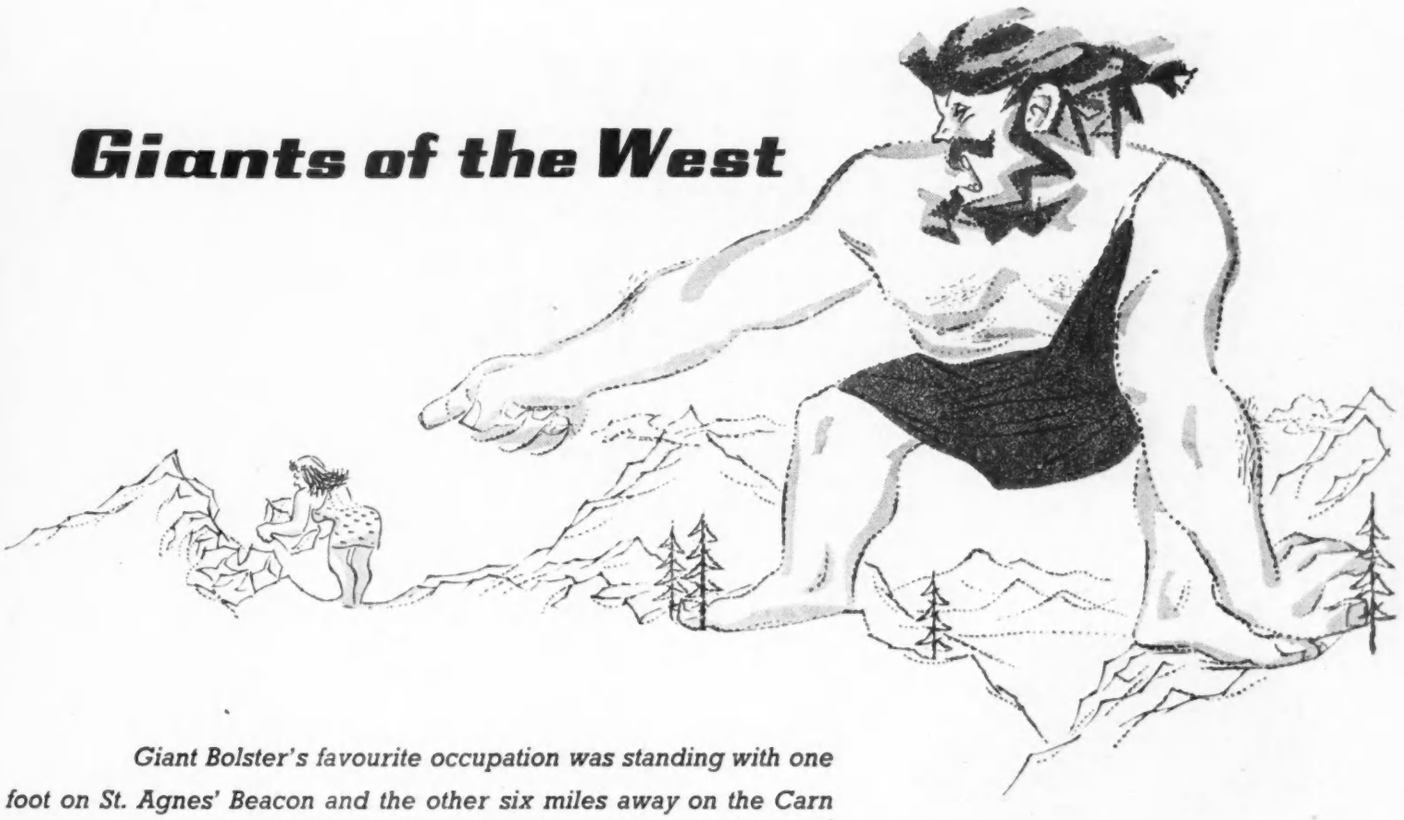


Mobile pump unit for oil for test rig purposes. Pressures up to 5,000 p.s.i. and volumes up to 6 g.p.m. Incorporates two 2-gallon Greer Mercier Hydro-pneumatic accumulators.

FAWCETT PRESTON & COMPANY LIMITED
(Incorporating FINNEY PRESSES)
BROMBOROUGH · CHESHIRE
Telephone: Rock Ferry 2201 · Telegrams: "Fawcett Bromborough"
Branch Offices in London, Birmingham & Glasgow.
A member of the Metal Industries Group of Companies

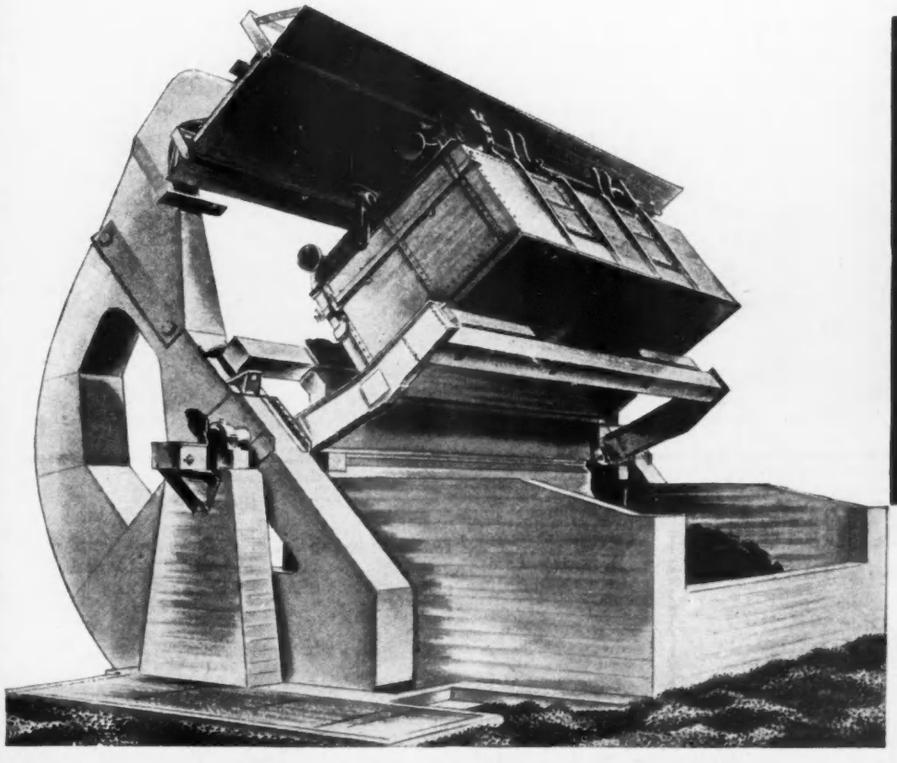
FF/180.

Giants of the West



Giant Bolster's favourite occupation was standing with one foot on St. Agnes' Beacon and the other six miles away on the Carn Brea hills, idly watching his wife quarrying granite. An imperfect husband, he is reported to have made a pass at St. Agnes herself—who promptly brought him to a gory end by a most unsaint-like trick. She agreed to marry him when he had filled a hole in a cliff at Chapel Porth with his blood—neglecting to tell him, however, that the hole was connected to the sea . . .

It would be interesting to have Bolster's opinion of modern giants of the West—like the S & H wagon tipplers—which patiently perform herculean labours with no trouble at all, domestic or otherwise.

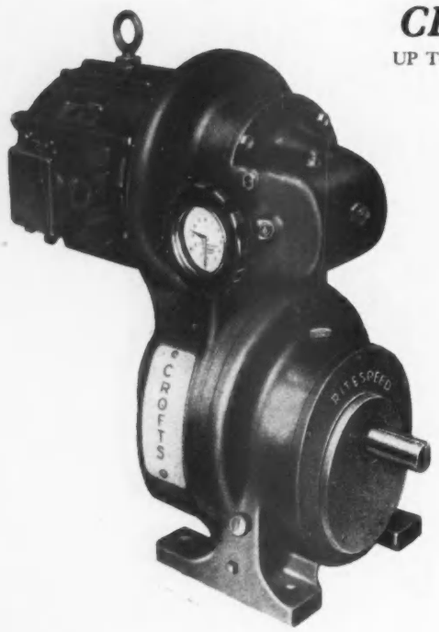


Strachan and Henshaw Ltd

STEELHOIST WORKS
BRISTOL ENGLAND

Telephone 78331

Wherever power is used Crofts Variable Speed Drives play a vital role . . .



CROFTS VARIABLE SPEED MOTOR GEARS

UP TO 5 h.p. AVAILABLE FROM STOCK—LARGER SIZES AVAILABLE WITH SHORT DELIVERIES

Variables up to 8.1 of a very wide range of output speeds

- Clean, safe, totally-enclosed drive
- Vertical, universal and flange-mounting types
- Combines electric motor, variable speed drive and world-famed Ritespeed reduction gear in one compact unit
- Simple indicator-handwheel
- Remote or automatic control supplied to order

Publication 5739

ALSO

Variable Speed Pulleys

Publication 353

C-JR Vary-Speed Controls

Publication 543 AA.

CROFTS (ENGINEERS) LIMITED

POWER TRANSMISSION ENGINEERS

Head Office: Thornbury Bradford 3 Yorkshire

Tel: 65251 (20 *lines*) *Grams: 'Crofters Bradford Telex'* *Telex* 51186

Branches at :

Belfast Birmingham Bristol Cardiff Dublin Glasgow Ipswich Leeds Liverpool London Manchester Newcastle Northampton Nottingham Sheffield Stoke-on-Trent

Subsidiary Companies in Canada, South Africa, U.S.A.

Worldwide Representation

THE ENGINEER

No. 5387 APRIL 24, 1959 VOL. 207

ONE POINT OF VIEW

At this year's conference on aircraft production of the Southern Section of the Institution of Production Engineers, the Lord Sempill Lecture was integrated closely into the theme of the meeting, " The Aircraft Industry—A National Asset," becoming one of three statements of different points of view. Lord Douglas of Kirtleside set a noteworthy example to authors of papers by adhering ruthlessly to the lines indicated by the title " The Operator's Point of View." His viewpoint being that of a short-haul operator with domestic bases, he gave weight to the observation that transport " aircraft in service can most easily be maintained and repaired, and, in addition, can be replaced and reinforced from United Kingdom resources, if they are of British manufacture." When Lord Douglas was on active service the Royal Air Force used a transport aircraft, known by him as the " Pionair," that was in service also with the R.A.A.F., the R.C.A.F. and the United States Army—the Douglas C-47 or " Dakota." Were his viewpoint that of a serving officer, one suspects that the situation that the R.A.A.F. and Tactical Air Command have the C-130 " Hercules " and the R.A.F. only a prospect of a different aircraft might cause him to doubt that an industry in being enhances the safety of the services and those they protect. The editor of the *Journal of the Royal United Service Institution* expressed a more credible view recently. " National pride (though it is called pig-headedness when referring to other countries) and the economic power of the big manufacturing concerns are powerful barriers to international sanity in this matter of an integrated Western weapons system."

On the subject of civil transports, however, Lord Douglas deserves the closest attention ; he observes that only three British post-war designs of aircraft have been successful as air-line equipment, and that each was produced by Vickers-Armstrongs, Ltd., and introduced into service by the air-line of which he is chairman. The introduction of each fleet of these aircraft cost B.E.A. approximately £400,000 each year (nearly £500,000 per annum in the case of the " Elizabethan " fleet of Airspeed " Ambassador " aircraft). Thus the operator desired a less rather than more frequent replacement of its equipment ; B.E.A. wished to use propeller-driven aircraft exclusively until 1964 (it will be recalled that the Bristol 200 was offered for service in 1962) and it would probably lose the air-line £500,000 to include the D.H. " Comet " in its fleet from 1960 to 1965. Thus it is easy to understand Lord Douglas's argument that the imposition of a " Fly British " policy entails financial support of the operator by public funds. It suggests, indeed, that the imputation in the recent report of the Comptroller and Auditor-General that B.O.A.C. as well as R.A.F. " Comet " aircraft were using engines on embodiment loan may not have been unfounded.

If, then, the aircraft industry is to be an asset to the nation, and not a liability, it is not easy to concur with Lord Douglas's view that the established transport aircraft programme can be and should be pursued without loss of confidence, particularly when the paper includes a table showing that the most advanced of foreign civil transports, the very fast Convair 600 with ducted fan propulsion, is due into service no later than 1961, whereas three of the British machines, the Vickers V.C. 10, the Airco D.H. 121, and the Short " Britannic," are not expected to be in service before 1964. There have, of course, been British export successes. But have those successes in the export drive been examined to ensure that they have not been due to the customer having only soft currency or inconvertible sterling, or having been offered " money back if not satisfied " terms ? Surely it can be argued that the policy of building aircraft to compete directly with craft likely already to be in existence abroad requires review. For it can only be successful if the craft so constructed are substantially superior in cost of maintenance, in running costs and in first cost. It is no easy task to ensure that they will be. It is also distressing, when we see a query appearing on Lord Douglas's aircraft fleet plan as a replacement for the D.C.3, to find no mention whatever of British designs aimed almost at the " bread-and-water " rather than the " bread-and-butter " traffic. Surely the " Rotodyne " and the " Argosy " merit, at the least, inclusion in a Table of " Post-War British Civil Transport Aircraft."

BIOMECHANICS

Many a time we have directed attention to the fact that the work of engineers is one that influences in some way or another most departments of modern life. Although the purist could probably find the exception, it is fair to say that, generally, the influence exerted by the work of engineers is beneficial. Certainly, it is an influence that is increasing, a matter which can be described as eminently satisfactory. Within the last few days, for example, two events have come to our notice which indicate the growing affinity between engineering and medicine and surgery. Our knowledge of the two latter sciences is obviously limited, but we, like the majority of people, are well aware that the human body is similar in many respects to a well-designed machine. Its components are susceptible to wear, corrosion and fracture which can quickly reduce efficiency and lead to total failure if corrective treatment or repair work are too long delayed !

Last Friday, the Institution of Mechanical Engineers presented for discussion a symposium of interesting papers on " Biomechanics." The term biomechanics is, of course, a convenient abbreviation of the " biology " element which involves medical science and the " mechanics " element which comprises the whole range of engineering science. One of the papers in this interesting symposium was a joint contribution by a surgeon (Mr. McKenzie) and an engineer (Brigadier Swettenham). It deals with the provision of a mechanical substitute—termed a prosthesis—for a missing or defective limb. In this paper, emphasis is given to the important fact that, although the prosthesis has to replace a human component, it does not necessarily follow that its mechanical design should copy that of the part it replaces. Amputation, of course, often changes the pattern of muscular control and weight bearing, and whatever form the

prosthesis takes, the main requirements are that it shall be comfortable, useful and of satisfactory appearance. Another engineer, Dr. Zarek, in introducing the symposium, pointed out that, for complex surgical procedures, biomechanics endeavours to apply the well-established engineering techniques of reproducing "actual service conditions." There is no doubt that the field to be studied is extensive, including, as it must, the human body and the "man-machine" relationship, and there is plenty of scope in it for the increasing application of engineering skill. Coincident with this symposium, but, so far as we know, in no way associated with it, the National Fund for Poliomyelitis Research announced that it had set up a committee to tackle the problems of the disabled from a combined engineering and medical point of view. This committee and its sponsors realise that there is an urgent need to discover how far the physical capabilities of an individual patient and the treatment he receives can be improved upon by utilising modern engineerng methods and the resources of industry. There are many projects already in the mind of the committee, including further studies in limb motion. The methods to be examined under this heading range from the simple to the most sophisticated, including servo-assisted motion. Research into artificial muscle and its control is also included. Work of this kind and of the kind expounded in the "Mechanicals'" symposium, we are confident, readily commends itself to engineers all over the world. The task of alleviating human suffering and disability offers increasing opportunity for the application of their talent.

PROCESSING COAL

On Thursday of last week Sir Ian Horobin, Parliamentary Secretary to the Ministry of Power, announced in the House that a Committee has been set up with the following terms of reference : "To review the work that has been done in recent years on the development of processes in which coal is the basic raw material and which will produce marketable products of a chemical or a gaseous or liquid hydrocarbon type ; and to make recommendations as to the direction of further research and development work on any such processes which appear to the Committee to hold promise of industrial applications, and as to the type of organisation or organisations best suited to carry out such work." It seems clear enough that the decision to set up this new Committee arises out of the present difficulty in selling certain grades of coal. In fact, however, engineers and chemists have been pointing out for years that to burn raw coal is largely to waste a valuable raw material. Soon after the war, for example, the late Sir Claude Gibb, in a James Watt Lecture, suggested in effect that all coal ought to be processed to gas, oil, and coke, and that even though the capital cost of the necessary plant would be high it would prove economic to do so. That lecture was presented in January, 1949. Some three and a half years later the Ridley Committee reported. That was at a time when the coal shortage was at its worst. Consequently that Committee was more concerned with the finding of ways of economising coal usage immediately than with the wider view. It did, however, regard any suggestion that turning coal into either gas or electricity was economically superior to the other as "unrealistic." If the Ridley Committee was right in its judgement—we confess to a doubt upon that point—then the only possible excuse for re-opening the subject now must be that coal has become difficult to sell.

No doubt the new Committee under its Chairman, Mr. A. H. Wilson, will take into account the considerable amount of research and development work which has been done into the subject by D.S.I.R. establishments and by industry. We rather expect, however, that the new department which the Coal Board has just set up, under the charge of Dr. Bronowski, to develop new processes for making smokeless briquettes from small coal, may more rapidly yield results. For it is, in particular, small coals of which the supply is excessive, whereas the demand for smokeless fuels is certain to grow as the objects of the Clean Air Act come closer to achievement. It will, however, be interesting to learn in due course whether the idea of treating coal as a raw material rather than as a fuel has now once more regained any economic attraction. Some at least of the Ridley Committee's objections appeared to arise out of an implication that there would need to be integration of, rather than competition amongst, the fuel and power industries. Politics, in fact, may have influenced its conclusions.

NOVEL BRITISH MOTOR-CAR

It was announced this week that there has been placed on the market a British motor-car of a design such as hitherto has only been available from foreign factories. This is, in itself, good news, because while import duties and quotas remain, one must wish to see a wide variety of designs produced by native engineers. The new model is not merely different from, but in some ways more advanced than existing British designs. Of particular importance is its use of universal joints which are lubricated and sealed when made, and thereafter need no maintenance. Lubrication of an installed roller bearing universal joint is difficult, expensive, and likely to be incomplete, and it must be hoped that these sealed joints will be given service trials in the widest possible range of applications. Where they replace existing joints on the new car, joints one size larger have been adopted to ensure a life equal to that of other major components, but that is a small price indeed to pay to eliminate an objectionable maintenance burden. Even before such joints were available in this country, some manufacturers had deemed it worth while to eliminate grease points on the suspension and steering, and naturally the new car has fallen into line. Thus, apart from 3000 mile checks on oil levels, the service interval becomes as long as 12,000 miles or twelve months. Even then all that is required is that six screwed plugs must be removed and oil injected (and the front hubs be refilled). This is a welcome development, but nevertheless one that was to be expected sooner or later. What distinguishes the newcomer is that, in contrast to almost all cars produced in this country since purchase tax has been levied on passenger vehicles, it even carries the reduction in the maintenance burden far enough to involve increased initial cost. It has, for example, a separate chassis to which the major components of the body are attached by bolts, and these components are so designed that the parts most likely to suffer accidental damage can be separated without extending the damage. Thus, provided always the manufacturer's paint plant proves able to hold close enough control over colour consistency, the repair of accidental damage should be markedly facilitated. It is encouraging to learn that already one insurance company is quoting a rate 12½ per cent lower than standard for this car, thus demonstrating that first cost is not, even under the present taxation system, all-important.

While the new car looks, and to superficial study is, Continental in concept, it is not in fact a car that would be built elsewhere in Europe—particularly, so small an engine would normally be carried by the driving wheels.

But there are many countries where cars are not asked to develop extreme traction on difficult surfaces, or to whisk round one corner after another, and there the new model should prove highly suitable. Moreover, the fact that this first modern British mass-production model has stopped short of a complete redesign does mean that there is ample scope for competitors to leap-frog over it to more advanced designs, thus increasing the range of different designs from which the customer can choose and learn. It should not be forgotten that this country has yet to build a successor to that unostentatious but excellent fast tourer, the Lancia " Aprilia."

INTUITIVE ERGONOMICS

Whoever " designed " the common housebrick ? Obviously one would say, a person without imagination or talent, for a brick is a singularly mundane thing. Even a Cubist could not claim it had merit ; that irresponsibly-named indentation, the " frog," would deter him ! From a purely practical point of view, is not the common brick a blatant insult to the twentieth century, and to the cult of automation and all that it implies ? How impudent that, even to-day, expensive facing bricks should be wantonly advertised as " hand made " ! For years, thoughtful consciences have been stirred by these immoderate facts and many attempts have been made to improve on the brick, but they have, up to now, been singularly unsuccessful. However, it seems that even this seemingly crude yet highly practical object is at last, even though slowly and grudgingly, giving way to the importunities of science. At this point we would refer the reader to page 625 of the last issue, where a note on the Building Research Station's investigations into new forms of bricks was given. There he will find a factual, unembroidered, account of what is actually being attempted, viz. to build a brick wall more logically and hence to make it cheaper, yet equally efficient and attractive. Interesting progress can be claimed for the Station's work. It rather seems that the 13in brick which was first tried has not proved the complete answer, and the most promising one is the 9in by 9in vertically perforated brick, which gives advantage whilst retaining the traditional skill of the bricklayer in the actual operations of building the wall. A start has been made, but clearly there is more work to be done, and many heads will be scratched, before those highly successful, yet highly intuitive and traditional, practices of brick makers and bricklayers can be replaced by a thoroughly explicit twentieth century system, combining all the best ergonomic teaching in the actual constructional operations, with completely automatic manufacture. Nothing less can be accepted as satisfactory to-day, and, indeed, we doubt whether anything much less would offer any significant economy over the practical art as it now exists. The scientifically minded can take encouragement from this work, not only because they will in the future be saving a few coppers when they need a brick wall, but also because yet another " brick wall " of prejudice has been breached by the scientific method.

TIMING MUSEUM ACQUISITIONS

On Wednesday last week, the Right Honourable the Viscount Caldecote, D.S.C., presented the forward fuselage of the one and only English Electric " Canberra " Mark V to the Science Museum in the presence of Wing Commander Beamont and Flight Lieutenant Hillwood, who, on August 26, 1952, flew the machine westward and eastward, respectively, over the Atlantic between Belfast and Gander, completing the return trip in 10 h 3½ min. The nose has been mounted and illuminated so that the compartment occupied by the pilot, navigator and bomb-aimer can be examined from outside by visitors, and it will be displayed adjacent to that very proud exhibit, the Vickers " Vimy " which made the first heavier-than-air non-stop Atlantic crossing in 1919. The new acquisition to the Aeronautical Collection was accepted by Dr. Morrison-Scott, who remarked that items such as these aeroplanes, with their achievements behind them, could be exhibited more easily than, for instance, the Zero Energy Thermonuclear Apparatus or the Martin " Vanguard," which might fail to live up to the claims made for them.

Impossible as it is to differ from the Director upon his point, we feel that it is worth our while to remind our readers that the best time for a museum to acquire a machine—or even an organism—is when it is still extant. For once it is obsolescent the hideous practice of cannibalisation may rapidly render good examples unobtainable. It is for this reason that we have repeatedly, when reviewing Science Museum publications, drawn attention to the absence from the collection of that masterpiece of the late " Joe " Craig, the " double knocker " Manx engine. Once this engine ceases to be made—and a change in the racing regulations is by no means inconceivable—the savage stresses of the circuits will swiftly sweep away the examples, numerous to-day, of one of the all-too-few British products that not only claimed dominion but went forth time and again to conquer in open contest. Now is the time, we suggest, for the Museum to acquire a " 30M." How regrettable that the prone-pilot pannier-tank weir-carburetter solo was not preserved when the amendment of regulations rendered it sterile! No doubt readers will be able to suggest several other examples of things which the Museum would do well to acquire immediately. But finance, we suspect, lies at the root of the fact that it does not always take timely advantage of its opportunities. It depends more upon gifts than upon purchases. Should it ?

The Engineer—100 Years Ago (APRIL 22, 1859)

" THE TYPE-PRINTING TELEGRAPH "

" We have given elsewhere a copy of the paper lately read by Mr. Hyde before the Society of Arts upon Professor Hughes' type-printing telegraph and mode of insulation. We were much disappointed at the very meagre nature of the discussion which followed its reading ; the more so as the subject had been previously well announced and was one of a very important character. . . . It must be obvious that any instrument which can successfully record in Roman type each letter of a message by a single wave, and upon one wire, must be infinitely superior to both the visual or non-recording needle instrument, which Mr. Hyde justly characterised as a primitive arrangement, and the Morse dot-and-dash recording instrument, by which five separate signals are required for the formation of each of several letters of the alphabet.

" The means by which the Hughes instrument accomplishes the printing of each letter of a message by one wave, are pretty fully described in the paper under notice. It must have been most mortifying to the inventor that, after having done all he could to bring his system fairly before the Society, no one should have given an opinion or raised an objection as to the character of the means employed in its application. The whole matter is left in a most unsatisfactory state. . . . The concluding remarks of the chairman, whose reputation as an electrician is so well known, and whose opinion upon the subject under discussion was confidently expected, were of a most evasive character. After digressing from the whole subject to make some unimportant general remarks on the policy of the Society of Arts, he dismissed the paper with a few random speculations upon the mode proposed for insulating. Of the type-printing system he said not a word ; nor did he so much as defend the needle system, of which he is the acknowledged exponent."

ENGINEERING, MARINE, WELDING AND NUCLEAR ENERGY EXHIBITION

No. III—(*Continued from page 604, April 17*)

THE Engineering, Marine, Welding and Nuclear Energy Exhibition, which opened at Olympia on April 16, continues until Thursday, April 30. On Monday, Tuesday and Wednesday next week it remains open until 8 p.m. Below we continue to describe selected exhibits.

Quasi-Arc, Ltd.

Amongst the equipment which has recently been developed by Quasi-Arc, Ltd., Bilston, Staffs, is a plant for the automatic welding of vertical seams, using the "Unionmelt" process. In this process, which can be seen in the diagram, Fig. 25, a molten pool is formed between the vertical plates to be welded, the sides of the pool being retained by copper shoes which form "dams." The molten pool is fed by the normal "Unionmelt" submerged-arc welding electrode and flux composition, and the welding head and copper shoes are raised progressively as the level of the surface of the weld metal rises. The speed of elevation is so arranged that the weld metal between the plates solidifies before it emerges below the lower edges of the copper plates, and the pool is protected from contamination by a layer of molten flux powder. All the variables in the process are automatically controlled.

Another recent introduction of this firm

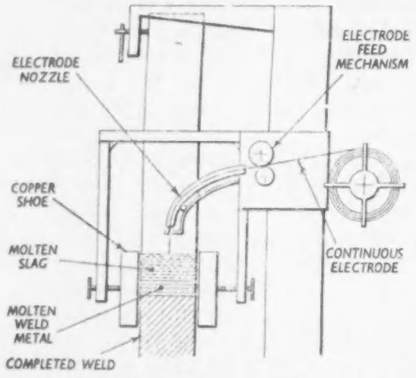


Fig. 25—Method of welding vertical seams automatically with "Unionmelt"—Quasi-Arc

is the twin-fillet self-propelled welding machine shown in Fig. 26. With this machine two horizontal-vertical fillet welds can be made simultaneously at speeds from 15in to 26in per minute. The machine is well-balanced for ease of manœuvring, and automatic guiding mechanism is incorporated for the welding heads. The equipment exhibited at Olympia is arranged for Fusarc/CO_2 welding, but it can readily be supplied for "Unionmelt" welding if required.

The firm's new design of "basic welding head" is intended to enable a complete automatic welding unit to be built up from five basic assemblies combined with a suitable power source. In this way, the advantages and economies of automatic welding can be obtained at a cost considerably below that of a complete "ready-made" installation, with the user providing only simple supporting structures to suit his own needs. Two versions of the basic head components are available, one set for "Unionmelt" submerged-arc welding, and another for welding by the "Fusarc" or "Fusarc/CO_2" processes.

In a "Unionmelt" welding set the five basic components are: a feed unit, comprising straightener assembly, drive motor and gearbox, but excluding the nozzle

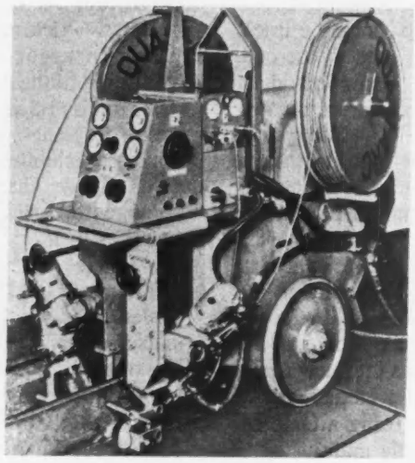


Fig. 26—Self-propelled twin-fillet automatic welding machine—Quasi-Arc

assembly; an arc voltage control cabinet; a flux hopper and bracket assembly; a wire spool and accessories such as nozzle assembly, feed rollers, &c. For "Fusarc" welding sets, the first two basic components mentioned above will fulfil the same functions and the welding head is completed by the provision of a CO_2 control box, an electrode spool and accessories.

The "Fusarc/CO_2" basic welding head is demonstrated on the Quasi-Arc stand, carrying out fillet welding of pipe flanges. For this demonstration the welding head is carried on a light welding head positioner and the pipe sections mounted on a standard 5 cwt manipulator. A "Fusarc/CO_2" pistol welder incorporating the basic head, is suitable for medium and heavy fabrication jobs where the work can be carried out in a screened welding booth. An introduction to the firm's range of manual welding electrodes, being shown for the first time, is the "Ferron No. 3." This electrode has been specially developed for the atomic energy industry and deposits a weld metal having exceptionally high impact strength at low temperatures (average 150ft lb at −10 deg. Cent.).

Rozalex, Ltd.

The protection of workers against skin hazards in industry is of particular importance, and many forms of barrier creams have been developed by Rozalex, Ltd., 10, Norfolk Street, Manchester, 2, for different applications. Creams are now available to protect workers' hands against the effects of the synthetic resins and their activators such as are now being increasingly used in foundries. It is not always convenient to wear gloves when handling "Fibreglass" from which minute spicules can very easily work into the hands and another cream has been introduced to afford a high degree of protection.

A new cream was formulated by the firm especially for the United Kingdom Atomic Energy Authority with the prime function of making it easier to decontaminate protective clothing worn by personnel exposed to radio-active materials. Until this cream was developed, protective clothing was difficult to cleanse, and it now makes decontamination a much simpler and more rapid process.

A waterless skin cleanser now being made is stated to be non-abrasive and completely harmless to the skin. It is simply applied to the contaminated skin area and gently rubbed, thereby liquefying and emulsifying dirt and grime so that the skin may be wiped clean and dry with a paper tissue or other convenient material.

C C. Wakefield and Co., Ltd.

A new mechanical lubricator, known as the "DP 60," made by C. C. Wakefield and Co., Ltd., 46, Grosvenor Street, London, S.W.1, which can be supplied in a number of sizes to give from one to thirty-two feeds, delivers

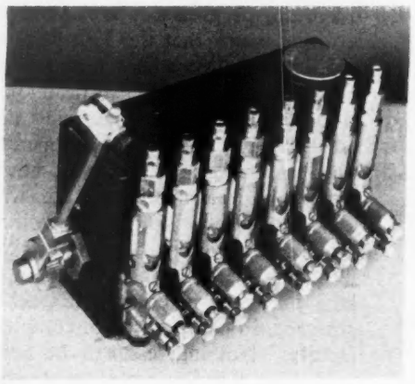


Fig. 27—Mechanical lubricator with eight feeds—Wakefield

oil at a predetermined rate and in predetermined quantity to the required points on a machine. The lubricator is normally actuated by the machine itself so that the oil supply automatically commences and ceases with the movement of the machine.

The sight feed glass fitted to a previous design of lubricator, which withstands pressures up to 600 lb per square inch, has been replaced by a "Perspex" tube and metal shroud capable of withstanding 2000 lb per square inch. Each feed unit can be regulated from zero to maximum by a regulator screw at the front of the corresponding pump unit. A separate flushing plunger provided at each feed operates independently of the pump plunger, so that a full flushing feed can be obtained irrespective of the position of the pump plunger. An air vent screw is

provided to each feed to disperse air locks should they occur when pumping commences, and each pump unit can be removed and replaced in one assembly.

The new lubricator (Fig. 27) is suitable for both steam and internal combustion engines and can be readily applied for the forced feed lubrication of other equipment.

W. C. Holmes and Co., Ltd.

A typical inert gas generator of Holmes-Kemp design, made by W. C. Holmes and Co., Ltd., Turnbridge, Huddersfield, is the equipment shown in Fig. 28, which has a capacity of 3000 cubic feet per hour. These generators are designed to produce an inert gas to any desired specification by the controlled combustion of fuel gas or fuel oil. They can be arranged to produce either continuously or intermittently, and the composition of the gas can be adjusted to meet specific requirements, either for delivery at low pressure directly to a process, or for compression and storage at high pressure for intermittent use. Where necessary, dryers can be incorporated to produce a gas having a low dew point, or by further processing the gas can be delivered in the form of pure nitrogen.

The generators employ a Kemp industrial carburettor in which the air and gas are premixed to give the required proportions for complete combustion. The design of the carburettor is such that it can be easily adjusted to pass any commercial fuel gas and still give the correct air/gas mixture necessary for complete combustion. Furthermore, it is designed to adjust automatically the quantity of air/gas mixture passing forward in accordance with demand. The output of the machine may therefore be cut to as low as 20 per cent of normal output, and at this duty the burners are still maintained alight, the turbo-compressor kept cool and the gas produced in excess of requirements vented to atmosphere.

The burners are mounted in the end of a horizontal water-jacketed combustion chamber in the equipment and the hot gases produced are passed into a vertical cooling tower from which the final gas leaves at a temperature about 15 deg. Fah. above that of the cooling water.

A totally enclosed solid desiccant dryer made by the firm (Fig. 29) is designed to give continuous moisture extraction from air or other gases. It operates on a preset cycle, the period of drying being followed by one of heating and cooling to drive off the adsorbed moisture. Twin towers enable continuous drying to be carried out, one tower always being in the process of reactivation while the other is drying.

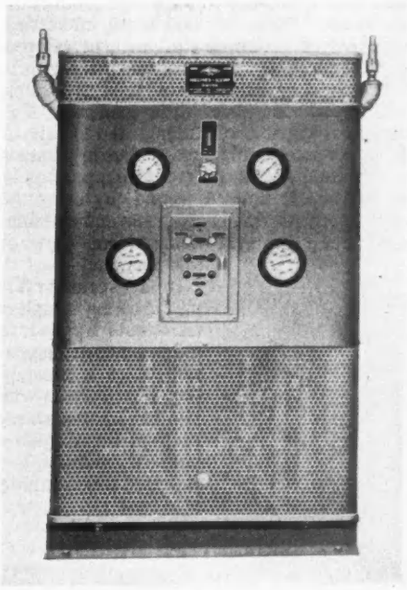


Fig. 29—Electrically reactivated solid desiccant dryer—Holmes

The smaller size dryers incorporate reactivation heating elements which are embedded in the dryer towers. Means for either steam or electrical reactivation can be supplied, and irrespective of the method of heating chosen arrangements can be made for either manual, semi-automatic or fully automatic control. To carry the moisture out of each tower during reactivation a small bleed of dried gas is taken from the outlet of the dryer and passed through the tower under reactivation. This gas is also allowed to flow through the tower during the cooling period and in this way the use of additional reactivation fans and the need for an external supply of cooling water is avoided.

The larger convection-cooled dryers utilise a separate reactivation system comprising a circulating fan, heater and cooler. One volume of the gas being handled is recirculated continuously at approximately atmospheric pressure, thus ensuring that there is no contamination of the processed gas.

Examples of the firm's dust collection equipment to be seen include the Holmes-Schneible multi-wash plant, the Holmes-Rothemuhle multi-cell dust collector for boiler plants, and a "Trione" electronic air filter.

F. Perkins, Ltd.

Engines representative of the wide range of industrial and marine units shown by F. Perkins, Ltd., Peterborough, include P3/144 industrial bearer and pedestal mounted engines, and a fresh-water-cooled S6(M) engine with a M.R.F.10B gearbox with a 3 to 1 reduction gear capable of developing 100 s.h.p. at 2000 r.p.m. There is also a marine version of a 1·6-litre "Four 99" engine, shown with a Parsons "D" gearbox, which develops 33 s.h.p. at 3000 r.p.m. for maximum continuous use. An industrial bearer-mounted "Four 99," complete with radiator, is on show and has a twelve-hour rating of 32 b.h.p. Three petrol marine outboard motors are on the stand and these are a 6 h.p. engine of 154 c.c. capacity, driving an 8in by 6½in twin-bladed propeller; a 16 h.p. unit of 2½in bore by $2^{1}/_{32}$in stroke and 325 c.c. capacity, fitted with a 9in by 10½in twin-bladed propeller; and a 690 c.c., 35 h.p. engine of $3\frac{1}{16}$in bore by $2\frac{7}{8}$in stroke, driving a three-bladed propeller.

A marine version of the "Four 270D" engine, the first direct-injection engine produced by the company, develops 58 b.h.p. at 2000 r.p.m. It has a 4·25in bore by 4·75in stroke and a capacity of 269·5 cubic inches, and can be fitted with Parsons mechanically operated reverse gearbox either as direct drive or with 2 to 1 or 3 to 1 reduction gear. Oil-operated Parsons or Self Changing gearboxes may be fitted. Fuel oil is injected directly through a four-hole injector offset in the cylinder head, into the combustion chamber, which is formed in the piston crown and is a toroidal bowl slightly offset from the centre of the piston. Keel pipe, heat exchanger or direct cooling is available. The industrial version of the engine develops

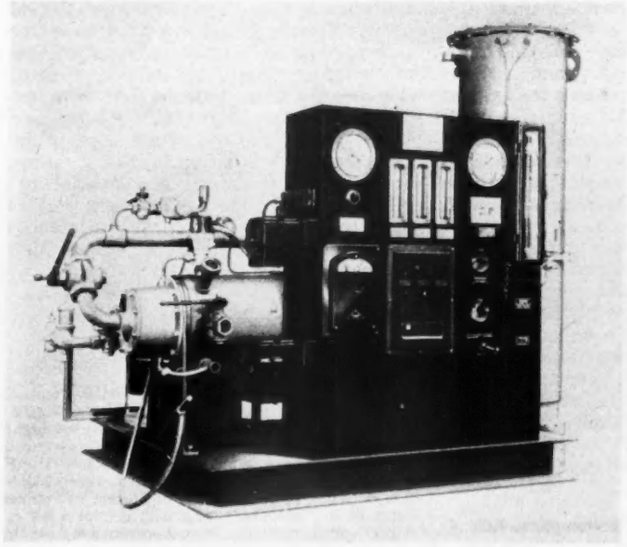


Fig. 28—Gas-fired inert gas generator of 3000 cubic feet per hour capacity—Holmes

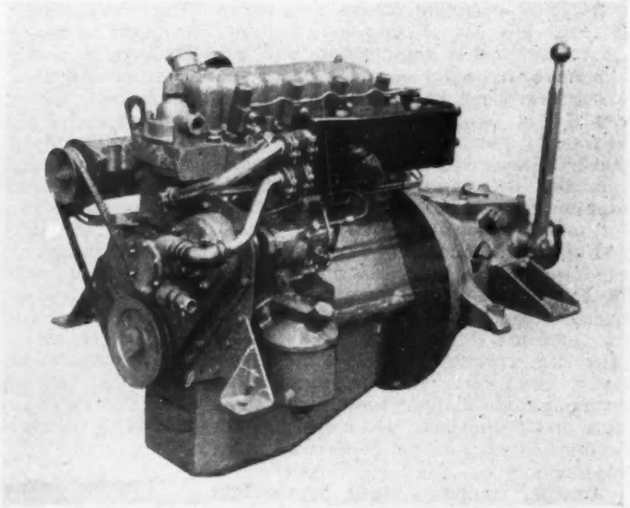


Fig. 30—Perkins "Four 99" marine diesel developing 33 s.h.p. at 3000 r.p.m.

56·5 b.h.p. at 2000 r.p.m., and a maximum torque of 172 lb-ft at 1000 r.p.m. A wide range of flywheels, flywheel and clutch housings and manifolds is available to increase the versatility of the engine.

Ozalid Company, Ltd.

For some time the use of microfilms for the storing and maintenance of duplicate records, drawings and other documents has been steadily increasing in industry, and the equipment required for this recording method is shown on the stand of Ozalid Company, Ltd., Langstone Road, Loughton, Essex. This firm states that, as a result of extensive research, it has developed methods by which completely satisfactory results can be achieved by the use of 35mm microfilm. With the equipment used sharp definition is obtained at enlargement and reduction ratios as high as 30 to 1.

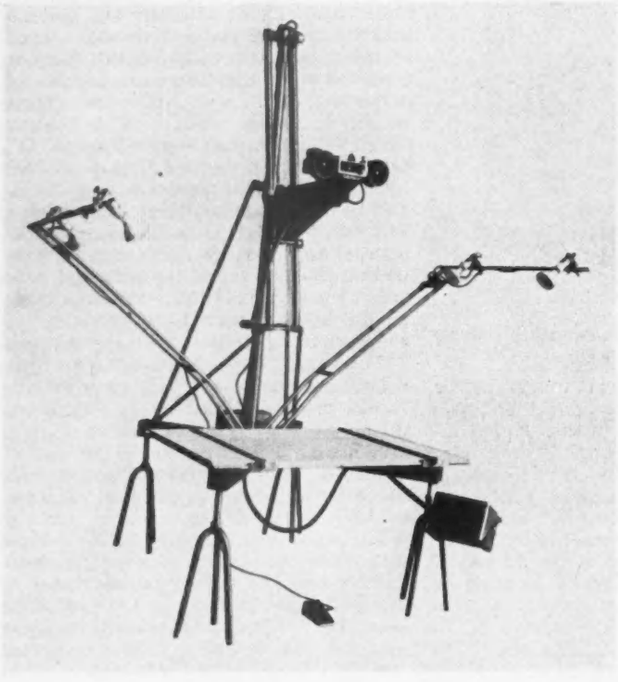


Fig. 31—Microfilm camera unit—Ozalid

A typical microfilm camera unit, shown in Fig. 31, has a precision planetary camera designed to use unperforated 35mm film and to reproduce accurately bound and unbound originals up to 37¾in by 53in. It can also be adapted to use 16mm film if necessary. The unit incorporates an automatic exposure control device which electronically determines the most suitable exposure for each original. It is adjustable for ten different degrees of film density and assists the production of evenly graded exposure from a variety of originals. All the controls are grouped on a small, easily-operated panel with optional foot control for exposure. Automatic film transfer after each exposure prevents a double exposure being made. For reprojection an enlarging head with point source light can be fitted on the equipment, and a light box can be fitted in place of the copy board when copying very old and faded originals.

Ancillary equipment made by the firm includes a developing unit, a film dryer, a reader/printer, an enlarger, a film duplicator and a portable reader.

Sir W. G. Armstrong Whitworth Aircraft, Ltd.

The display on the stand of Sir W. G. Armstrong Whitworth Aircraft, Ltd., Baginton, near Coventry, shows some of the firm's manufacturing facilities and techniques which have been developed to overcome production problems. There are also some interesting examples of electronic equipment developed and produced by the firm, one of which is a five-channel cathode-ray tube recording equipment, complete with camera. The camera is capable of filming, at the rate of 300in per second, high-speed rises in pressure or vibration and it can record happenings at up to 100,000 times a second, by using the electrical measuring instruments and cathode-ray tube displays which form part of this exhibit.

In a working display showing sampling techniques applied to industrial instrumentation, there is a sampling switch fitted with two banks of contacts, each with twenty-four contact segments, and designed for sampling speeds up to 12,000 revolutions per second. This equipment, it is stated, can deal with 500,000 measurements of strain, temperature, vibration, pressure and position a minute. This information is then collated automatically on associated equipment, and the readings taken either on site or transmitted by land-line or radio-link to a central recording station. The equipment can be fitted to a wide variety of machinery to assess a safe working life for any part under all conditions of temperature and climate, or it can be used for regulating production flows.

Also shown is a sweep oscillator and vibration controller for environmental or dynamic testing. With this oscillator components from structures subjected in service to mechanical resonance can be tested over a wide range of frequencies from 10 c/s to 32 c/s. The frequency range on the oscillator can be varied to suit the experiment and the equipment will automatically sweep this frequency range at a wide variety of selected speeds for as long as necessary.

Laurence, Scott and Electromotors, Ltd.

Two electrically driven cargo winches, one for a.c. and the other for d.c. supply, form the main exhibits on the stand of Laurence, Scott and Electromotors, Ltd., Norwich. The 5-ton capacity "Corrector" winch is a high-performance machine incorporating a lightweight a.c./d.c. motor generator, a form of drive which prevents frequent heavy current surges on the line and provides a wide speed range and flexible performance by means of variable voltage control. Electric braking is provided to avoid heavy brake wear and the maximum speed is automatically controlled in accordance with the load on the winch.

The winch has a full-load speed of 100ft per minute rising to a maximum speed of 400ft per minute on light loading. As can be seen from the illustration, Fig. 32, all of its parts are readily accessible for inspection and maintenance, and, since all operational switching is on the shunt circuits, there are no contactors subject to heavy wear.

The direct-current winch shown is a self-contained model of the familiar "Selector" winch of which type many are in use with deck-house mounting contactor gear. Although this arrangement of contactor gear provides facilities for convenient inspection and adjustment under all weather conditions, there are occasions when the provision of covered accommodation for the contactors and resistances is inconvenient and expensive. The makers state that as a result of practical development it has been found possible to simplify the control equipment and to reduce its dimensions, so that the contactor gear can be housed in a weatherproof box mounted alongside the winch bedplate and the resistances in a compartment in the bedplate itself. The dimensions of the housing are such that the view over the winch is not obstructed. The self-contained "Selector" winch retains all the previous performance characteristics, and gives speeds up to about 100ft per minute on full load, rising to 350ft per minute with a light hook.

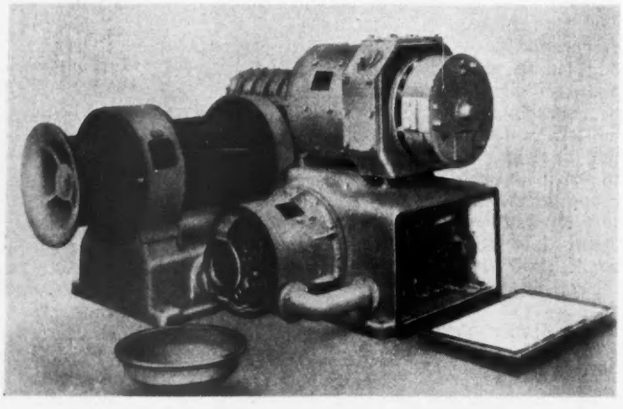


Fig. 32—Scott "Corrector" winch for a.c. supply, with covers removed to show accessibility of contactor gear and motor generator set—Laurence Scott

(To be continued)

POLYSTYRENE CAPACITORS.—We have received from Salford Electrical Instruments, Ltd., Magnet House, Kingsway, London, W.C.2, a catalogue folder giving details of three types of polystyrene capacitors covering an overall range from 51μμF to 510,000μμF and for working voltages up to 2000V a.c. or d.c. They are made in normal cylindrical form, or in "pancake" form with central 6 BA or 4 BA hole for fixing. Typical applications are in electrical storage and computing networks, in tuned circuits such as those of i.f. transformers, and in filter networks where high stability and close tolerances are required.

Resignalling at Newcastle

No. II—(*Concluded from page 606, April 17*)

The new route-relay interlocking brought into service at Newcastle upon Tyne on Sunday, April 12, 1959, is one of the largest in the world, and handles an exceptionally heavy traffic. In the previous article the background to the installation, and the interim stages, were described ; the present article deals with the new signalbox.

THE broad picture of evolution in signalling technique represented by successive installations at Newcastle Central Station can be summarised as follows.

(1) *Mechanical Signalling*.—Four signalboxes, 564 levers, one bridge only from south of the Tyne.

(2) *Electro-Pneumatic Signalling* (1906).—Three signalboxes, 462 levers, two bridges from south of the Tyne.

(3) *Route-Relay Interlocking* (1959).—One signalbox, 641 route switches, controls area covered by previous signalling at Central Station, as well as Manors Station.

Although the new signalbox controls the working over 10 miles of track extending to, and including, Manors Station, the High Level and King Edward bridges, and on the Carlisle line up to, but excluding the entrance to, Forth goods yard, provision has been made for possible future extension. The High Level and King Edward bridges are approximately at right angles to the general direction of the railway in the Central Station itself.

The Control Room

The general design of the control room (illustrated here) follows that pioneered at York, but opportunity has been taken to include a number of improvements. The traffic regulator's desk is mounted on a raised dais from which he has an excellent view over the control panel itself, and the illuminated diagram behind.

There is a glass panelled soundproof room for the station announcer using the public address system, from which the announcer has clear vision of the panel, and the train describer display indicators. The control panel, and the diagram mounted in the wall behind, is arranged in four sections, with one signalman operating each section.

Between the outer and inner switch consoles are short sections of console on which are mounted the train describer control pushes and the signalmen's telephone switches. The sections are set at different angles and at a suitable height to permit any one of the four signalmen and the traffic regulator having an unrestricted view of the whole panel. The overall size of the panel is 53ft long and 4ft 6in high. Train describer display indicators are mounted above this panel. On these indicators are shown the descriptions of all trains or engines (excepting those in the platform area), each description being related to the signal which the train or engine is approaching.

The individual track circuits are depicted on the illuminated diagram by distinctive colours, and when any track circuit is occupied by a vehicle or vehicles a red light at each end of the track circuit is illuminated. Once a route is cleared for the passage of a train a series of small white lights appear on the diagram, so that a succession of lights appear over the length of track for which the route has been cleared. These white lights remain illuminated until the movement has been completed and the route restored to normal. Altogether, there are 2840 route lights mounted in the illuminated diagram. The illuminated diagram also displays a number of green lights linked with push-button controls situated on the station platforms. When a train at any particular platform is ready to start this fact is indicated to the signalman by the official in charge operating the appropriate press button, which, in turn, causes the appropriate green light to flash. This light is extinguished when the platform starting signal is cleared.

The clearing of a route for the passage of a train is accomplished by turning the route switch for the particular route involved. These route switches are of the plug-in type and are situated on the sloping portion of the console. They are arranged in two groups. The lower group contains all switches relating to signals with even numbers, which control routes reading from right to left of the diagram. The upper group contains the switches relating to signals with odd numbers, which control routes reading from left to right. The route switch knobs are coloured red for the main colour-light signals and white for the subsidiary signals. On each of these groups of switches there are three small indicating lights (one red, one green and one white) for each signal concerned. The red light indicates when the signal is at danger. The green light indicates when the main colour-light signal is clear and the white indicates a clear subsidiary signal. With each signal there are route switches controlling each of the various possible routes. Each route switch is engraved with the identifying number of the route to which it applies and mounted above the switch is a small engraved plate describing the route it controls.

Provision is made for operating points individually and independently of normal route setting arrangements by separate point switches, each having a normal, reverse and central position. These switches are normally maintained in the central position and must be in this position before the points can be operated by the route switches. The position of the points is indicated to the signalman by lights. For each pair of points, there are three small white lights ; one indicates when the points are in the normal position, one indicates the reverse position, and the third (placed centrally between the other two) indicates by a flashing light when the points are not operating correctly. When this occurs, the signalman can move the points by means of the switch, and this movement will usually restore correct operation. Each individual point switch is equipped with an engraved plate giving the identifying numbers of all the other pairs of associated points which have to be suitably positioned in order to release the points concerned.

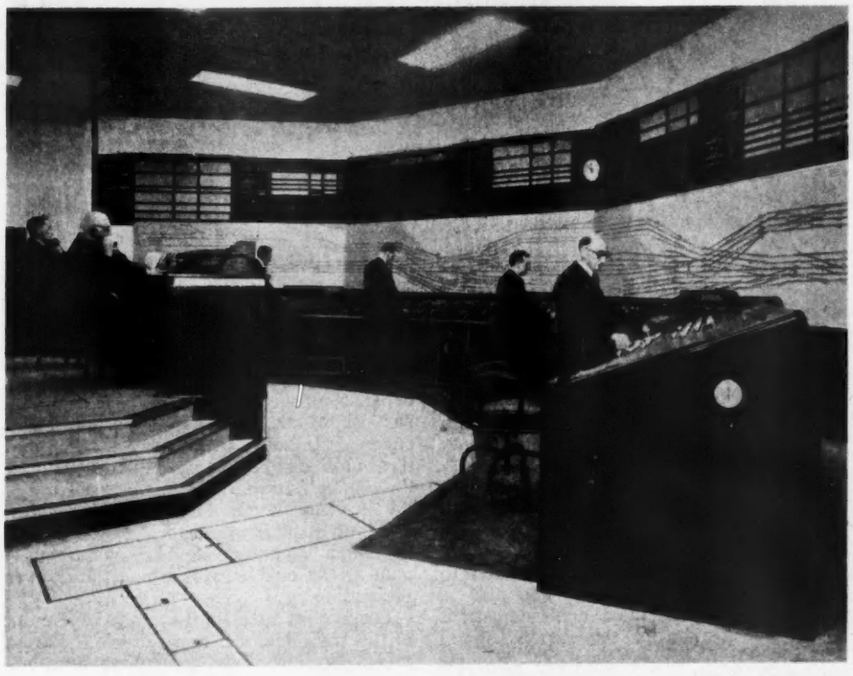


Fig. 5—Control room in operation. On the left the traffic regulator and a telephone attendant are receiving incoming calls. Centre and right are the four signalmen at work on the four sections of the switch console. Three of the track diagram and train describer panels can also be seen above the switch console

Operating Procedure

The main signal controlling the entry of any train into a particular section of line can only be cleared after the various intervening subsidiary signals up to the next main signal have been proved to be clear, and the operation of the appropriate route switch clears the signals and sets the points for the route required to be covered. The turning of the route switch first energises the main signal lock relay reverse, which in turn energises the associated subsidiary lock relays reverse (where provided). The intervening subsidiary signal lock relays then reverse in sequence up

to the next main signal. All the signals are now ready to be cleared. The last subsidiary control relay then proves the track clear and the points correctly set before the signal goes to the clear aspect. The intervening subsidiary control relays then operate similarly in sequence back to the main signal controlling entry to the section, the signals going to the clear aspect. The condition now is that all intervening control relays are energised ; there is a full track circuit control throughout the whole route and all signals show the clear aspect. It is, however, possible in an emergency for the signalman to put any of the intervening subsidiary signals to danger after the train has entered the section.

It is frequently required to bring a train into an already occupied section, for example, to a platform, part of which is already occupied by a train. This working is made possible by separate use of the subsidiary signals, each one of which has a separate controlling switch in the signalbox. The main signal is, of course, maintained at danger but the subsidiary signal at the point of entry gives a " C " (i.e. " Calling-on ") indication to the driver of the train and the intervening subsidiary signals are cleared individually up to the point required.

The installation embodies " approach-locking," a safeguard to prevent the route being restored and a conflicting route cleared in the path of an on-coming train. The presence of a train on the track circuit approaching any signal automatically prevents the " normal " lock relay from being energised. This prevents any restoration of route until the train has either moved on to the next track circuit or the approach locking has been released by the automatic time delay releasing mechanism.

The Relay Room

The relay room illustrated here is 85ft long by 56ft wide and 18ft high and adjoins the control room. It has two floors and accommodates all the interlocking relays, together with track, point indication and signal control relays, as well as many " stick " and other types of relay. All the control relays are of the detachable top type. Interlocking relays are 24V d.c. solenoid-operated with twenty-six normal, twenty-six reverse independent contact arrangements. Each lock relay is operated from its own rectifier to eliminate the possibility of false energisation which would exist if a common power supply was used for all interlocking relays. The complexity of the interlocking and control circuits is illustrated by the fact that there are approximately 850 lock relays and 2000 other relays for control, indication and releasing purposes. The wiring between these relays has necessitated the use of almost 400 miles of single-core cable. The connections with the control console and the diagram panel are in multi-core cable. The whole of the wiring is carried out in flame-proof V.I.R. cable.

Track Circuits, Power Supplies and Cabling

The track circuits, of which there are 260 in the controlled area, are a.c. reactance-fed, the feed set consisting of a 150VA, 110/12V transformer and adjustable reactance. The track relays are double-element resonated-vane relays with 110V supply for the local coil and a 1·2/2V supply for the control coil.

Reliable and comprehensive power supplies are essential for a signalling installation of this magnitude. Electricity is obtained from two independent public supply points at 660V single phase. The reliability of both supplies is such that a stand-by alternator has not been provided. The incoming supplies are connected to the 660V busbars through oil-filled circuit breakers. Ring main supplies to the external signalling functions are connected to these busbars through air-break circuit breakers, as are the 660/110V transformers feeding the signalbox 110V busbars. From the 110V busbars, supplies are taken to the d.c. supply rectifiers, indication transformers and the 110V distribution system in the relay room.

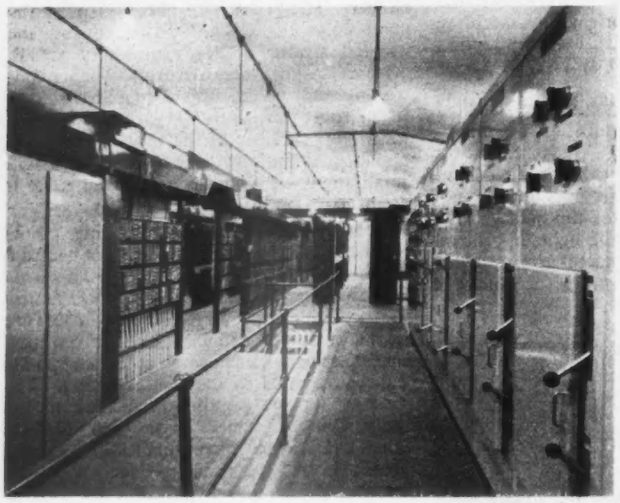
The supply transformer for the subsidiary signals has both 110V and 55V secondary outputs for day and night supplies. The " tapping " in use is remotely selected from the control room. The reduction of voltage at night is to prevent undue dazzle. Comprehensive instrumentation is provided to indicate the load conditions and this is supplemented by coloured light indications as to the position of the various circuit breakers and the supplies available. Remote indication of the main supplies is also provided on the traffic regulator's desk. All the switchgear is " back-of-board " mounted on the power supply panel with flush mounted instruments. Automatic carbon dioxide fire protection apparatus is provided in the power cubicle.

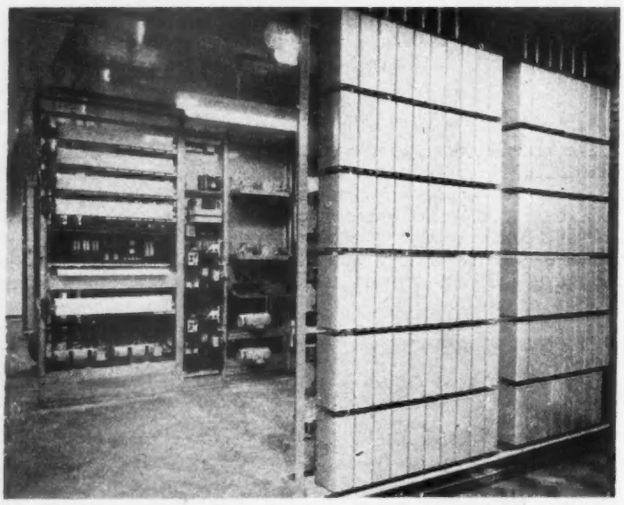
There are more than fifty housings throughout the signalling installation where cables are terminated, catering for signals, points and track circuits. Some of them are steel enclosures, but where a large number of cables converge brick buildings have been erected. The cabling between the various housings and the signalbox is carried out in 35 miles of multi-core, oil-impregnated, paper-insulated, lead-sheathed armoured cable. Between the housings and the signals, point machines, and so on, rubber-insulated polychloroprene-sheathed cable has been used. The cables are supported alongside the tracks by hangers or run in cable ducts, and the main run is carried into the relay room over a steel gantry which spans four sets of freight lines and carries forty-five fifty-core cables. Inside the relay room eighty-five multi-core cables are terminated on fused links which protect the equipment from fault currents and surges occurring on the electrified lines.

Train Description Apparatus

The comprehensive train describer installation in the new box is linked with the adjacent boxes, and the display indicators are mounted above the panel diagram in the control room, so arranged that information giving the class and destination of each train is illuminated in a panel giving an indication of the actual signal which the particular train is approaching. The code giving the description and destination of the train is set up by the signalman from whose section the train is proceeding and once this is done the apparatus works automatically, being controlled by the signals and the passage of the train over certain track circuits. Initially, the display at both the transmitting and receiving ends is shown as a flashing indication with a buzzer sounding at the receiving station. The buzzer is silenced and both displays are steadied by the depression of an " acknowledge " key by the signalman at the box towards which the train is proceeding.

Provision is made for the manual operation of this train describer apparatus in the event of any portion of the controlling signalling apparatus being out of order. There is special provision for light engine movements between the Heaton motive power depot and Manors Station bay platforms. The descriptions for these engines, on clearing the appro-





Figs. 6 and 7—(Left) Relay room with low-voltage distribution panel on right. (Right) The telecommunication room: this view shows part of the train description, public address and telephone apparatus

priate signals, are transferred from the Newcastle receiver display to the transmitter display and transmitted to the forward signalbox automatically. The train describer apparatus employs an all-relay system, using telephonic apparatus; the relays are mounted on "jack-in" panels to facilitate routine maintenance. The apparatus in the Newcastle signalbox is mounted on open racking, but in the outlying signalboxes it is housed in dustproof cubicles.

Telecommunications

Telephonic communications of various kinds are required on any modern signalling installation to enable the signalmen to keep in contact with the staff on the ground, with adjacent signalboxes, with engine crews at signals, and with the local traffic controllers. These facilities are necessary for the rapid dissemination of information vital to the smooth working of a heavy concentration of both passenger and freight traffic. Therefore, a considerable number of telephone circuits converge into the nerve centre of the signalling installation—the signalbox. Access to the circuits can be made by the signalmen at various keyboards which are built into the signal and point switching console. The traffic regulator on the dais behind the signalmen can, by means of a large telephone keyboard, communicate with the station and sidings staff at numerous points in the vicinity of Newcastle and signalmen as far afield as Durham, Blaydon, Tynemouth, Killingworth, and so on, and with the controllers at Newcastle and Sunderland traffic controls, who are engaged in arranging traffic movement over the whole of the Newcastle district.

Automatic ringing out and selective "calling-in" facilities on each circuit ease the burden on the signalmen and traffic regulator. To make a call, the operator selects the correct waystation code, which is displayed on an illuminated stencil above the appropriate circuit key, and then after setting a dial situated at the end of the keypanel to this code, presses a button and waits for the distant person to answer the ringing call, which has been transmitted to line by means of automatic switch and relay mechanisms situated in the telecommunications apparatus room (illustrated) adjoining the signalbox. An incoming call causes a white light to flash or "blink" in front of the operator and the depression of the appropriate circuit key instantly connects the caller to the operator, by means of a telephone handset.

The signalmen and traffic regulator in the new box can make immediate contact with the signalmen in the adjacent signalboxes at King Edward Bridge, Forth, Manors North, Argyle Street, Heaton and Greensfield, by means of separate direct telephone circuits. A total of forty-seven direct telephone circuits link the signalmen with specific signals throughout the signalling area, which enable engine crews to converse with the signalmen. A nest of calling lamps, arranged in an arc on each of the telecommunications panels, mounted in the signal and point switching console, indicates the particular signal post from which the call is being made.

Snow and frost can cause serious delays to services due to the blockage of points on the permanent way. To help to alleviate delays during these difficult weather conditions, twenty-nine telephone plug points, known as "Emergency Point Zone Telephones," have been fixed at specific important point switching centres. The plug points connect with the telephone panels in the signalbox, thus enabling the signalmen and the permanent way staff (who are provided with portable "plug-in" telephones) to converse with each other whilst testing the movement of the points during the snow clearing operation.

A special telephone keyboard has been incorporated in the signal relay room, at the rear of the signalbox control room, to enable wide coverage of communication to be established with the signal and telecommunications maintenance staff over the whole of the signalling area. This is achieved by fitting "plug-in" telephone sockets in all the cable termination housings which are situated along the lineside, linking these to the keyboard through various circuits. The maintenance staff carry a portable "plug-in" telephone, the insertion of which causes an alarm and flashing light to appear on the keyboard in the relay room, thus bringing on to the circuit the staff who are maintaining the plant at the signalbox. To enable the latter to call up the outside maintenance staff, a series of loudspeakers has been arranged into zones situated along the trackside through the medium of which a distinctive interrupted high-frequency tone can be transmitted by depressing a key in the relay room. Situated at the important East and West Junctions are further loudspeakers, known as "Talk-Back" loudspeakers, through which the signal relay room maintenance staff can converse with their colleagues who are maintaining the point motor and detection mechanisms and track circuit functions. This system can be extended to the signalbox control room in times of emergency for use by the traffic regulator.

Platform announcements will, after the opening of the new signalbox, be made by the announcer from the specially soundproofed glass panelled room situated at the back of the signalbox control room. From this vantage point she has a clear view of the signalling and train description diagrams and the main North and South platforms.

The power panels, consisting of large, highly polished black panelling bearing numerous voltmeters, ammeters and switching mechanisms enable the telecommunications maintenance staff to keep a close check on the state of the battery plant and overall performance of the system. In the centre of the apparatus room is the main distribution frame, on to which are terminated all the telecommunication cables entering and leaving Newcastle Central Station. These cables serve all the telephones on the signalling system, the Newcastle railway telephone exchange, and long-distance trunk circuits between London and Scotland. At this point, the maintenance staff have complete control of all telephone cabling systems in the Newcastle area, enabling alterations in routing and testing of faults to be carried out quickly. A special fusing and cable termination system has been incorporated on the frame to protect staff and equipment from fault currents and surges occurring on the Newcastle electric traction system. Situated near the cable frame is a rack bearing rows of small electric clocks: this is the master clock system which is accurately controlled from a temperature-regulated pendulum timepiece mounted on the wall of the apparatus room. Each slave clock monitors a system of clocks and indicates the exact timing of that circuit. The administrative offices, Newcastle signalbox and adjacent signalboxes, &c., are all controlled from this source, thus enabling synchronism and exact time to be maintained throughout this area.

Much of the equipment in the telecommunications apparatus room has been designed on the "jack-in" principle to simplify fault finding and maintenance. It is estimated that there are approximately 100,000 exposed contacts in this room, all of which must be maintained in a clean state if the various telecommunications facilities are to operate in an efficient manner, and to assist in attaining this condition humidity-controlled clean air is injected into the room and the used air extracted.

Planning and Installation

The initial signalling scheme was prepared by the former London and North Eastern Railway under the direction of the late Mr. C. Carslake, then Signal and Telegraph Engineer of the North Eastern area. It was continued by Mr. J. H. Fraser, O.B.E., when signal and telecommunications engineer of the North Eastern Region of British Railways, and it has been completed under the direction of Mr. A. F. Wigram, A.M.I.E.E., signal engineer, North Eastern Region. The civil engineering and constructional work was designed and carried out under the direction of Mr. A. Dean, M.I.C.E., chief civil engineer, North Eastern Region, British Railways. The internal work (wiring, erecting relay racks, &c.), has all been done by Westinghouse Brake and Signal Company, Ltd., with the exception of the telephone and train description apparatus, which has been installed by Standard Telephones and Cables, Ltd. The outside work relating to signals, points, track circuits, cabling and cable housings (steel) was carried out by the signal engineer's staff, who also provided the temporary circuits in the existing signalboxes to control the new signalling prior to the opening date.

The Change-Over

The station was completely closed to traffic for three and a half hours on the Sunday morning, but from midnight on Saturday, April 11, special arrangements were in force to reduce local movements in the station to a minimum, while dealing with the regular through traffic. In the ordinary way, practically all through express passenger trains change engines in Newcastle, and there is a considerable number of light engine movements, both steam and diesel, across the High Level and King Edward bridges to and from the large motive power depot at Gateshead immediately opposite to the Central Station on the south side of the Tyne. To avoid these movements entirely it was arranged for through trains changing engines to stop at Heaton, adjacent to the other large motive power depot in the Newcastle area, but 1½ miles on the Edinburgh side of the station and outside the area affected by the present signalling change-over. Relieving engines for all trains affected were sent from Gateshead to Heaton prior to the period of change-over, and stabled there till their particular trains arrived. Some passenger trains were terminated at outlying stations, and a bus service provided to bring passengers into Newcastle.

International Congress of Photogrammetry, 1960.—The ninth International Congress of Photogrammetry is to be held in London from September 5 to 17, 1960. This will be the first time the congress has been held in the United Kingdom. The organisation of the congress is in the hands of a congress board, composed of representatives of the Royal Institution of Chartered Surveyors, the Photogrammetric Society and the National Committee for Photogrammetry, under the chairmanship of the president of the International Society for Photogrammetry, Major-General R. Ll. Brown, formerly director general of the Ordnance Survey of Great Britain. Colonel J. B. P. Angwin is executive congress director. Communications should be addressed to him at 18, Cavendish Square, London, W.1.

Canadian Atomic Energy Development

JAMES CLAYTON LECTURE

By Dr. W. B. LEWIS

The development of atomic energy in Canada was discussed in the James Clayton Lecture given by Dr. W. B. Lewis at the Institution of Mechanical Engineers in London on April 10. After having outlined the present Canadian reactor programme he examined the problems of designing heavy-water reactors for low-cost power production, with particular reference to a 200MW (E) reactor requiring 100 tons of heavy water and designed for a burn-up rate of about 10,000MW days per tonne of uranium. Abstracts from the lecture are reproduced below.*

OUR present situation is that there are eight Canadian heavy-water reactors to mention, shown in Table I, three in operation, three under construction, one under development, and one in the preliminary design stage. First, the NRX (40MW) and NRU (200MW) are in full operation at Chalk River. Some of the auxiliary systems of NRU have not yet been put into commission because the reactor is still too new. A slightly modified version of NRX is being built in India, the CIR (Canada–India Reactor), and should be completed in mid-1960. A 20-electrical-megawatt demonstration power reactor, NPD–2, is under construction at Rolphton, near the Ontario Hydro Des Joachims plant, about 15 miles from Chalk River. A preliminary design for a 200MW(E) power plant was completed in 1956 and a development programme is under way towards detailed design and construction; this project is called CANDU (Canada Deuterium Uranium Reactor) and is aimed at generating electric power competitively in the Ontario Hydro System, where the competition for the future is being set by coal at 8 dollars per short ton.

TABLE I—*Canadian Heavy-Water Reactors*

1	ZEEP	Zero energy reactor for fuel and lattice research	First operated September, 1945
2	NRX	40-thermal-megawatt experimental reactor	First operated July, 1947
3	NRU	200-thermal-megawatt experimental reactor	First operated November, 1957
4	CIR	Canada - Indian reactor; 40-thermal-megawatt experimental reactor	Under construction
5	NPD-2	Nuclear power demonstration 20-electrical-megawatt generating plant	Under construction; to operate in 1961
6	ZED-2	Zero energy reactor for lattice experiments; larger than ZEEP	Under construction
7	CANDU	Full-scale power reactor, 200 electrical megawatt	Preliminary design study, 1956–57; under development
8	OCDR	Organic liquid-cooled deuterium reactor, 150 electrical megawatt	Conceptual design, 1958, by Canadian General Electric Co., Ltd.

Seven separate high-temperature loops are in operation in the NRX reactor and provide the background of experience at full temperature and pressure on which the power reactors are being designed. Six loops are water-cooled; one of these, the central thimble, has a 24ft long Zircaloy pressure vessel, 4·5in external and 3·15in internal diameter, that has been in used since March, 1957. The five other water-cooled loops of miscellaneous design are now being made interchangeable to take fuel elements up to 9ft long by 0·8in diameter. The fuel can be made up of short segments and changed with the reactor shut-down without disturbing the stainless steel pressure tube. The NRX operates with shut-downs scheduled for these changes approximately every three weeks. The seventh loop is new and uses an organic liquid coolant.

The NRU reactor is designed to take three large loops with 4in diameter tubes passing right through the reactor. Two are being commissioned for water cooling, but the third has been deferred, owing to changes in ideas.

NRX and NRU have many other facilities but I will not digress to discuss them as they are not so directly connected with the engineering of power reactors.

For lattice experiments we have ZEEP in operation and a larger zero energy reactor, ZED–2, under construction. For reactivity measurements we have the PTR (Pool Test Reactor). This reactor is of the conventional swimming pool type, using enriched uranium as fuel, but has for its special purpose canned graphite as moderator. Its purpose is to measure (by the "swing" or pile oscillator technique) the neutron reactivity of materials such as fuel elements that may be highly radioactive.

All the other reactors mentioned are moderated by heavy water and will operate on natural uranium fuel. Some enriched fuel is, however, used in NRX and ZEEP, made with either uranium–235 or plutonium. We have now the most extensive known experience on the use of plutonium as a working fuel. About 5·5 kg of plutonium has been re-irradiated in NRX in the form of plutonium-aluminium alloy rods. So far we have obtained from this about 1500MWD.

The eighth heavy-water reactor is a proposed design using organic liquid as the coolant. It is a proposal of the Canadian General Electric Company team, who are now engineering with us the demonstration power reactor, NPD–2. They have called their proposal the OCDR (Organic Cooled Deuterium Reactor). It is a power reactor that seems to promise lower capital costs than the heavy-water-cooled reactors, but not lower fuelling costs. Interest in this is responsible for the organic liquid cooled loop in the NRX reactor that I mentioned.

Fuel and Cladding Ruptures

We have deliberately gained a lot of experience on defected or ruptured fuel. We have also encountered unexpected fuel failures that extend the repertoire. For use in high-temperature (525 deg. Fah.) water, UO_2 clad in zirconium alloy is highly promising. The UO_2, after irradiation, if not before, is a sintered compact liable to crack. It is not bonded to the cladding, so when a hole or a crack penetrates the Zircaloy, fission product gases from the interior are released to the water. Their radioactivity appearing in the water signals the rupture. It is very rare for a serious situation to develop rapidly so the reactor is not shut down and irradiations have been continued for many months.

When contemplating the operation of a large power reactor, however, we envisage that as soon as convenient any ruptured fuel element would be removed. To identify the failed element the water from each channel in the reactor would be sampled. The water coolant recirculates so rapidly that following a rupture the level of radioactivity rises in all the channels. We have found that a sudden change in operating power level usually releases a burst of fission products and this promises a valuable technique for locating the faulty element. Having shut a reactor down, it has proved often very difficult to locate even a rod with a severe rupture.

The many small advantages to be gained from changing fuel at power cumulatively make it almost essential for economic power. First and most important is the small margin of excess reactivity wasted after a fuel change. Secondly, the ability to remove faulty fuel without loss of operating time reduces the integrity required of fuel cladding to a simple economic assessment of fuel supply cost. If, for example, 5 per cent of all fuel supplied to a reactor fails prematurely, this represents less than a 5 per cent increase in fuel supply cost, or less than 0·005d. per unit.

This licence in fuel integrity must not, however, be interpreted loosely. Very serious ruptures are possible with badly designed fuel. For example, if a large void space is left inside the fuel cladding, and if a small hole penetrates the cladding, the void is liable to fill with water when the reactor is shut down. On start-up, this water may develop a very high pressure within the fuel and explode it. We do not consider it safe to use flat fuel elements of UO_2 except in very small sizes for a similar reason. Even though no internal void is initially present, a small excess internal pressure will distend the sheath. We encountered serious trouble in the NRU reactor in this way from the use of unbonded flat sheathing over uranium metal. The pressure drop along the coolant channel was enough to distend the sheath when punctured at the high-pressure end.

These waterlogging effects in UO_2 offer, therefore, an advantage if kept to small voids, because they serve to identify a failed fuel element, but threaten disaster if the void is too large. Our experience may still be keeping our fuel designs too cautious, for we try to avoid serious failures. Properly designed UO_2 fuel promises to be very safe and preferable to any other economical uranium fuel yet known.

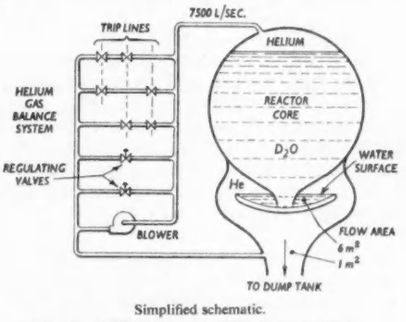
Reactor Control

We envisage heavy-water power reactors controlled entirely by the level of the cool heavy-water moderator. The NRX reactor was designed from the start for the moderator level to be adjustable. Originally, however, this was only used for coarse control of reactivity, and independent absorber rods were used both for fine control and for rapid shut-down. Following the accident [resulting from a power surge in NRX reactor in December, 1952] we planned to change this to eliminate the fine control rods and to share the shut-down action between a smaller number of shut-down rods and the dumping of the moderator.

* Vice-president for research and development, Atomic Energy of Canada, Ltd.

Since May, 1958, the NRX reactor has operated with this system. Heavy water flows out from the reactor vessel continuously and is pumped back. The rate of flow is controlled by three valves in parallel. On shut-down three additional ports are opened that lower the heavy water to a preset level. Experience with this system has been very satisfactory and gives confidence in the systems planned for NPD–2 and CANDU.

The system promises some advantages for the power reactors, both in safety and economy. I will mention just two points, both of which are merits of the gas balance system of suspension planned for NPD–2 and CANDU. Any freely falling shut-down rod to be effective must control a significant reactivity, say, 5 mk each, if there are fifteen of them. A bursting pressure tube can produce a disruption of the thin calandria tube and either interfere with the free fall of a shut-down rod or even possibly knock aside one that is down. This has to be ensured against by multiplicity of the rods and provision of an excess number. This raises initial and maintenance costs. In contrast, when no shut-down rods are provided and the moderator is suspended by balance of gas pressure, any rupture into the heavy-water moderator will upset the gas balance in such a way that the moderator is rapidly dumped out. It can be arranged that this rate of dumping is much greater than any inflow from the coolant. The second point is illustrated by the system of control valves used on the NPD–2 shown in Fig. 1. There are three



Simplified schematic.

Fig. 1—NPD-2 reactor shut-down system

independently operated trip circuits in parallel. Each controls two of the six valves. Any two trip lines would open two valves in series in the same line. This allows gas to flow to equalise the pressure over the two heavy-water surfaces and thus cause the heavy water to be dumped. This system has the essential property that any one trip line may be deactivated and tested without disturbing the protective action of the system. In the actual design for NPD–2, the whole set of six valves is duplicated in a parallel set of tubes. The deactivation of individual trip lines may be applied as a routine test, with the reactor in full operation and the actual motion of the valves may be observed. If this action is recorded in the log, then study of the log reveals whether this routine check is being made frequently enough to be sure that the chance is negligible that two trip lines would simultaneously fail in such a way that the necessary number of valves is not opened. If this chance is not negligible, the routine or the equipment must be changed. The system is also very resistant to major disasters. Suppose, for example, all the valves get frozen shut. Provided this is discovered, no harm need result. Merely stopping the helium blower will still dump out the heavy water.

To give a further example of subtleties of reactor safety systems, we have a general rule that any changes to the control system should, if possible, be made with the reactor at power. For example, suppose a resistor is to be changed in an electronic instrument that is part of the control system. Suppose, further, that by some error the mechanic misinterprets his instructions and changes the wrong component. In operation there are three instruments constantly intercompared and any discrepancy is brought to the attention of the operator. With the reactor shut-down, the mistake might pass unnoticed, and, worse still, the mechanic might have repeated his error in all three instruments, so that the fault might be undiscovered until too late.

I hope I have said enough to indicate that what may seem obvious cannot be allowed to pass unchallenged and the intuitive reactions of engineers and operators are not always to be trusted.

With a heavy-water power reactor, even when shut down, the neutron flux is not too small to observe. This arises because the photoneutrons released from the heavy water by the γ-rays from the fission products in the fuel are multiplied by fission. It is therefore desirable to keep the neutron level under observation and connected to the control system. The neutron level may be four or five decades below that at full power operation. Control is derived from the level, its rate of change, and the rate of change of the logarithm of the level.

Designing for Low Cost

The cost of power may be written as

net annual expenditure/electricity sent out.

Many studies, however, make a significant error in assessing the net annual expenditure, so this must be carefully defined. In ordinary financing, a debt can be balanced by an annual payment. Such payments are rightly included in the net annual expenditure. The error often made is an overestimate of the debt. Reducing the debt lies in the hands of the reactor design engineers as well as the operators, and the amount of the reduction may be as much as half a reactor charge of fuel.

The usual convention is to make up the annual expenditure from four components, namely :

(1) Annual charges on capital (except fuel), that is, interest, dividends, depreciation, insurance and taxes.

(2) Cost of fuel supply at the average rate, that is, cost of annual purchases less the credit on spent fuel.

(3) Annual charges on fuel inventory, that is, interest, insurance and taxes. (Note that depreciation on fuel is a fuel supply cost.)

(4) Operating and maintenance.

Another convention capitalises only half of the fuel that is actually in the reactor. The justification is that the fuel earns its replacement value while in the reactor. This latter convention is liable to underestimate the debt.

The trouble arises from the initial charge of fuel in the reactor and the approach that can be made to equilibrium fuel replacement at the average rate. I have mentioned the advantages of continuous on-power fuelling, so I shall take this as the example although it is not the simplest. Initially, the standard fuel will have a reactivity higher than the average in the equilibrium charge necessary to give the full power output from the reactor. As this new fuel runs down to the equilibrium state it is possible by shifting the position of the fuel within the reactor to avoid removing and renewing any. In an ideal case this amounts to a free yield of energy from half a reactor charge and reduces the fuel inventory debt by this amount. Such an ideal is, however, not easy to achieve.

One simple procedure has been worked out for bidirectional slug fuelling, subject to an imposed condition that fuel shifting operations shall never greatly exceed the rate necessary at equilibrium. The result is shown in Fig. 2. Details are given in AECL Report No. 696. About 35 per cent of a reactor charge is saved and some production of uranium-233 from thorium is taken as a bonus.

Regarded another way, it can be argued that if every piece of fuel, including the first loading, received a standard irradiation, then the second convention of capitalising only half the fuel in the reactor could apply and the saving should have been half a reactor charge. This convention underestimates the debt both because such a full irradiation does not appear to be practicable, and also because more than half the reactor fuel is chargeable until fuel replacement is under way.

Having drawn attention to these less familiar points in nuclear power cost studies, and passing over the standard desire to reduce the capital cost and the fabricated fuel price, increase the burn-up and the thermal-to-electrical conversion efficiency, and limit the fuel inventory, it is interesting to look at some figures relating to reactors of high power, such as 200MW(E), where the scale factor changes some preconceived ideas.

Heavy water is quite costly and the early reactors such as NRX were designed to

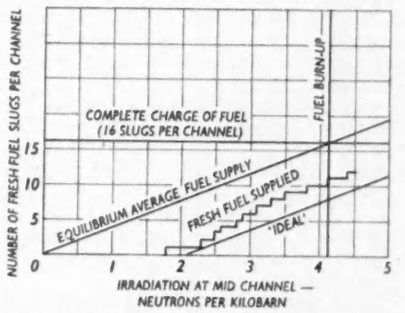
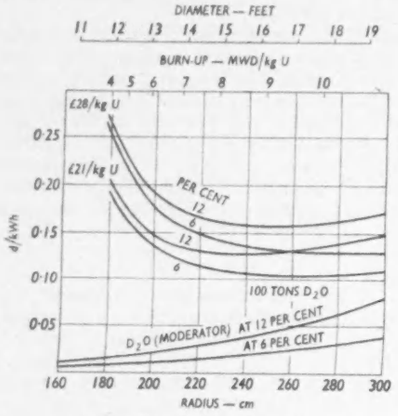


Fig. 2—Fuel savings from special initial refuelling procedure

require the least amount practicable. It may be observed, however, that increasing the amount of heavy water can reduce the neutron leakage from the reactor and thereby increase the burn-up of the fuel. For power reactors there is, therefore, an economic balance between the amount of heavy water and the fuelling cost. The optimum will depend to some extent on the method adopted for financing, but fortunately for a reactor generating 200MW(E) or more, the optimum is rather flat over the whole range of practical reactors and financing methods. This is illustrated by Fig. 3.

These curves are worth studying because they reveal the essential merit of the heavy-water reactor for low-cost power production. They make it clear that the achievement lies not only in choosing heavy water and natural uranium, but in providing 100 tons of heavy water and taking 200MW(E). It is also necessary to keep the neutron wastage in the reactor core low and otherwise choose a good nuclear design. When all this is done, the costs that result are lower than many engineers expect, even when it is noted that fractional additions are necessary to both components to reach total costs. These additions cannot reasonably be included in such a general illustration because they are not direct functions of the reactor volume. They are : (1) the annual charges on the fuel inventory (these may amount to

10 to 15 per cent of the fuel supply cost in typical reactors of this power rating); (2) the extra heavy water outside the reactor required in cooling circuits (this is more a function of the power than of the reactor volume); (3) the make-up for heavy water losses during operation (this is not likely to be proportional to the volume). The remaining contribution to the total cost of power, namely, the charges on the capital



200MW plant, 7000 hours per year.

Fig. 3—Cost of fuel supply + D_2O moderator. Neutron wastage in core 60 barns per initial fissile atom

cost of the rest of the plant, will also have a component dependent on the volume.

The heavy-water component of the curves in Fig. 3 is derived very simply. An annual charge rate of 6 or 12 per cent is assumed and applied to the total cost of heavy water at 28 dollars per pound required to fill the reactor volume which is $5 \cdot 8r^3$, where r is the radius indicated by the abscissa. The reactor shape is a right circular cylinder of length $1 \cdot 85r$, this being close to an optimum.

The fuel component of the curves is the result of a much more complex calculation that relates burn-up of natural uranium to neutron wastage. This is explained in Appendix I.

These neutron losses are due to absorption by materials in the core and escape owing to the finite size of the reactor. The larger the reactor, the less the leakage or escape. It is owing to this factor that the burn-up increases with the reactor size. The curves have been drawn for a constant wastage by absorption in the core. The level chosen for this is low but practical. To achieve it involves designing the fuel cladding and coolant channels with a minimum of metal and choosing a zirconium alloy of high strength and low neutron absorption. The wastage is 60 barns per initial fissile atom, and in reactivity units this is about 45 milli-k (4·5 per cent k). The leakage for a radius of 270cm is about equal, making a total of 90 milli-k, which allows a burn-up of about 10,000MWD per tonne of uranium, as shown.

The curves are drawn for a net thermal-to-electrical efficiency, that is (electricity sent out)/(energy released by fission and radiations) of 27·5 per cent. This is rather higher than we have used previously in design, but it seems to be now a practical goal. The breakdown is given in Table II. Previously,

TABLE II—*Thermal to Electrical Efficiency*

	MW		Percentage
Heat from fission and subsequent radiations	728	...	100
Heat developed in and lost to moderator	51	...	7
Heat transported by steam	677	...	93
Turbine cycle efficiency 32 per cent for dry saturated steam at 465 deg. Fah., 490 lb per square inch gauge: condensed to 1in of mercury pressure:			
Gross generated power	216·5	...	29·8
Auxiliary power and transformer loss	16·5	...	2·3
Power sent out	200	...	27·5

lower steam conditions seemed optimum which was due to setting the stress limit in the Zircaloy pressure tubes at 10,000 lb per square inch. Now, however, by taking note of the properties of the zirconium alloys used in Russia, and of our own experience of irradiated Zircaloy, we expect to rely on a higher mechanical performance.

In case anyone is inclined to use these curves to justify a minimum amount of heavy water, I should remind him that the fuel has to be designed for the peak power rating or neutron flux in the reactor. An important cost factor is the ratio of the peak/average power rating of the fuel in the reactor. If the reactor volume is large, it is possible to flatten the neutron flux without adding very much neutron leakage. This we expect to achieve primarily by leaving a generous volume of heavy-water reflector round the core, but also by taking less burn-up from the fuel in the outer regions. In such a reflector the neutron flux can be as high or higher than anywhere in the core and this helps to assure a low peak-to-mean ratio such as 1·85 for the whole reactor. In a small reactor such flux flattening adds considerably to the neutron leakage and so reduces the burn-up and raises the fuelling cost.

It is satisfying to note from the curves that the provision of such a reflector is not uneconomic.

Transient Xenon Poison and Flux Changes

Some concern has been raised over the possibility of neutron flux instabilities associated with the transient fission product xenon–135 poisoning, and with changes in the reactivity coefficient of moderator temperature as plutonium replaces uranium-235 in the fuel. The latter effect appears to be negligible, being overshadowed by a more rapidly acting negative temperature coefficient in the fuel from the doppler broadening of the uranium–238 resonances. On the xenon problem we appear to be requiring a reactor size that is lower than the instability limit of radius which is about fifteen times the migration length but may be near enough to encounter sluggish damped oscillations of the neutron flux pattern. This makes us wary of introducing strongly absorbing control rods, and points to the potential advantage of control by a poison distributed throughout the moderator if that were practicable. Using instead moderator level control seems likely only to run into transients of significant magnitude in the first day or two after a shut-down.

We operate the NRU reactor with a peak neutron flux in the uranium fuel of about $3 \times 10^{14}n$ per square centimetre per second. At such a level the xenon poison transient

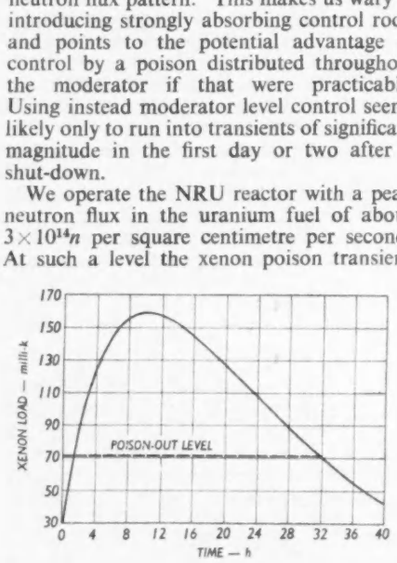
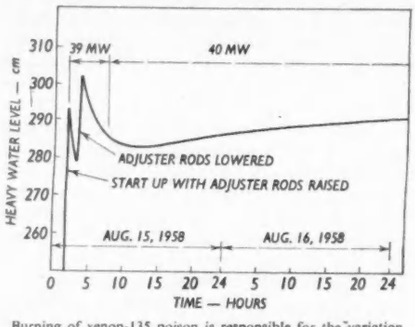


Fig. 4—NRU reactor. Xenon poison transient from equilibrium at 200MW

following shut-down is very large (Fig. 4). For the power reactor it seems unnecessary and uneconomic to use a flux higher than perhaps $1 \times 10^{14}n$ per square centimetre per second as an average across a fuel bundle. In this case the xenon poison transient is significantly less.

In the NPD–2 reactor we plan to use a booster fuel rod of enriched uranium–235 (or plutonium, but the U–235 is now cheaper) to obtain thirty minutes over-ride of the xenon poison transient by an extra 3·5 milli-k of reactivity. This fuel rod would be withdrawn when power is re-established, so it should last for twenty years. It would be cooled by heavy water drawn from the cool moderator, so the heat would not be used. This design appears much cheaper than any other method of adding this amount of reactivity. For the large reactors it is not certain that such a provision would be worth while. We may accept a shut-down following

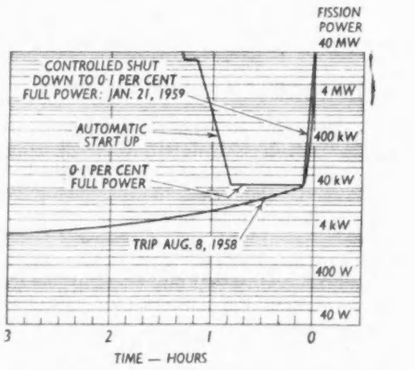


Burning of xenon-135 poison is responsible for the variation required in heavy water level following a one-hour shut-down.

Fig. 5—Automatic start-up after a reactor trip at 0032h

extended operation at power as inevitably poisoning the reactor until the xenon decays.

Figs. 5 and 6 are taken from NRX experience and illustrate some of the transients connected with xenon poison. To those familiar with low flux graphite-moderated reactors, the rapidity of the automatically controlled start-up may be of interest.



A rapid start-up is required after low power operation to burn xenon-135 poison.

Fig. 6—Comparison of controlled shut-down and trip NRX reactor

Conclusion

In conclusion, may I explain that I have tried to pick some highlights of experience and important factors of design for economic high-power, heavy-water-moderated reactors.

Looking back, our rate of progress since 1951 seems slow and this must be attributed to the circumstance of abundant power in which we live. It is only looking forward that we see the complete utilisation of water power resources in important industrial areas. Costs of power will still be low, and this sets us a challenging target. Now the

scientific and technical problems have been reduced to manageable proportions and brought into the realm of engineering and estimates. Others may be able to take advantage of our development, and we hope we shall not find ourselves standing alone much longer in this low cost competition.

Appendix I

The method of relating burn-up of natural uranium to neutron wastage is that discussed under the heading, "Neutron-balance Calculations," in a paper to the 1958 Geneva Conference on the Peaceful Uses of Atomic Energy, page 205, "Long Irradiation of Natural Uranium," by D. S. Craig, G. C. Hanna, D. G. Hurst, S. A. Kushneriuk, W. B. Lewis, and A. G. Ward. It is described in more detail in Appendix A of DM-52, "Cost Comparisons for Enriched versus Natural Uranium Fuel and for Zirconium versus Stainless-steel Fuel Sheathing in Bidirectional Slug Fuelled Reactors," by W. B. Lewis, AECL Report No. 651. The case used for Fig. 3 is Case 56–4 of that report.

Approximately the thermal neutron excess from the fuel that balances the neutron wastage in the core, together with the leakage, is given by $\sigma_e = Y\varepsilon p - \Sigma(N\sigma)_{fuel}$ in bifa (barns per initial fissile (i.e. U–235) atom) where $Y = \Sigma(N_5\eta_5\sigma_5 + N_9\eta_9\sigma_9 + N_1\eta_1\sigma_1)$ is the yield cross-section of the fissile isotopes U–235, Pu–239, and Pu–241 ; ε is the fast fission factor and p the U–238 resonance escape factor ; σ is the absorption cross-section of the material designated by the subscript. The "fuel" includes all fission products and the plutonium and uranium isotopes (including U–236) that arise by irradiation in the uranium fuel. N is the number of atoms per initial fissile atom.

When evaluating the neutron wastage in the fuel sheathing, moderator, pressure tubes, and other structures in the reactor, it must be noted that the neutron flux may be higher than in the fuel and a significant correction is necessary for this.

For the curves in Fig. 3 the leakage has been calculated on a one-group neutron diffusion model for the reactor core in terms of the geometric buckling, B_g^2. For the shape assumed, $B_g^2 = (2{\cdot}945/r)^2$, where r is the radius. The migration area, M^2, is assumed constant and assigned the value 384 square centimetres. Depending on the design, M^2 is found to lie usually in the range 300 to 400 square centimetres. The fractional leakage is $B_g^2M^2/(1+B_g^2M^2)$ in reactivity units. In bifa it is $Y\varepsilon pB_g^2M^2/(1+B_g^2M^2)$. For Case 56–4 $Y\varepsilon p \simeq 1328$ bifa for average fuel in the reactor when fuel is discharged after an irradiation of 2·5 neutrons per kilobarn.

Bibliography

The NRU, NPD–2, CANDU and OCDR reactors are discussed in the following papers to the 1958 Geneva Conference on the Peaceful Uses of Atomic Energy :—

P.211 : "The NRU Reactor," by Winnett Boyd, F. W. Gilbert, G. C. Laurence, and I. N. MacKay.

P.209 : "The Canadian NPD–2 Nuclear Power Station," by I. N. MacKay.

P.208 : "A Study of a Full-Scale, Uranium and Heavy Water, Nuclear Power Plant," by H. A. Smith, W. M. Walker, and N. L. Williams.

P.210 : "A Heavy-Water-Moderated Power Reactor Employing an Organic Coolant," by M. J. McNelly.

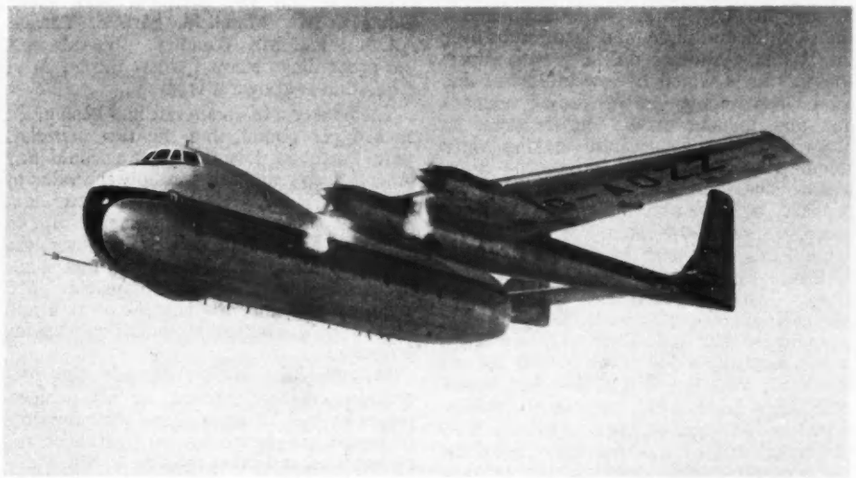
A general review will be found in :

P.183 : "Canada's Steps Towards Nuclear Power," by W.B. Lewis.

The above papers contain references to more detailed reports.

Nylon Driving Chain.—A chain of nylon construction throughout is now made by George Goodman, Ltd., Robin Hood Lane, Birmingham, 28, for light positive driving applications. At present this chain is made in 8mm pitch only and although it will sustain a static load of 5 lb it is recommended that it should be used where driving loads do not exceed 3 lb. The firm states that other sizes of this design of chain will be made in accordance with demands in the future.

The Aircraft Industry



The seventh conference on "Problems of Aircraft Production," held by the Southampton Section of the Institution of Production Engineers on Thursday and Friday, last week, had as its theme "The Aircraft Industry—A National Asset." The Conference concluded with an open forum in which questions were answered on the subject "The Importance of the Aircraft Industry in the National Economy." Great importance was attached to the future of freight aircraft, of which we illustrate one of the latest, the "Argosy."

THE seventh conference on "Problems of Aircraft Production" promoted by the Southampton Section of the Institution of Production Engineers took place at the University of Southampton on April 16–17, 1959. The chief speaker at the luncheon which opened the proceedings was Air Chief Marshal Sir Claude Pelly, K.C.B., C.B.E., M.C., Controller of Aircraft, Ministry of Supply, who observed that the Ministry considered that it had in hand three major military projects, the T.S.R.-2, a medium-range freighter, and a large long-range freighter.

The conference proper opened with the presentation of the Lord Sempill paper by Lord Douglas of Kirtleside, G.C.B., M.C., D.F.C.* The paper was a contribution to the theme of the Conference, "The Aircraft Industry—A National Asset," and was devoted to "The Operator's Point of View." There was no discussion of this lecture, and the proceedings were continued by Mr. P. G. Masefield, M.A., F.R.Ae.S., M.Inst.T., Hon.F.I.Ae.S., C.I.Mech.E.,† giving "The Industry's Point of View." This paper formed a complement to that reviewed in our last issue about the aircraft industry of the United States : it related that while aircraft production in 1946 had been 1900 aircraft at an average cost of £2 per lb, in 1958 it had been 800 aircraft at £12 10s. per lb ; thus the ratio of expenditure in those two years had been 3·5 : 1. On the subject of aircraft costs, a chart showed that the price of the proposed Bristol 205 would be £700,000 —the "Britannia" cost £1·1 × 10⁶, the D.H. "Comet," Convair 880, and Boeing 720 £1·3 × 10⁶. Over the years since the last war, 23 per cent of the output of the aircraft industry had been exported.

In the discussion following this paper, Mr. W. E. W. Petter reminded the conference that long jumps over several generations of developing aircraft were perilous, and that "political" pressures to perform them should be resisted. He deemed a supersonic commercial aircraft beyond attainment by Great Britain in the immediate future, and drew attention to the unsatisfied demands for an up-to-date equivalent of the Bristol "Freighter," for a small fighter to use the existing carriers of many navies, and for aircraft to fly into city centres. The countries of the Commonwealth might well consider that their needs were not being met by the British industry. Mr. Masefield reiterated his view that there was a need for a replacement for the "Viscount," as also, of course, for the D.C.-3, and added that an "Anson" replacement, a five-seat light twin, could be sold in great numbers. In all probability an aeroplane designed for the lowest costs would still use piston engines. (He later amplified this to indicate an air-cooled sleeve-valve plant.)

Professor E. J. Richards observed that exports were best based on a domestic market : would not the achievement of automatic landing allow internal air services to be developed ? Mr. Masefield replied that the tax on fuel rendered commercial services prohibitively costly in Great Britain. Executive aircraft might be an important market, but no firm was going to purchase one after the warning given by the closing of Croydon Airport when it was one of the busiest in the country. Mr. A. Vines pointed out that there were many problems in delivering the goods that this country sold all over the world—if air freighting could solve them, hundreds of aircraft could be employed. Mr. Masefield considered that to make work for such a fleet rates equivalent to 1s. per ton-mile must be offered—many shippers were not prepared to pay extra to have goods moved faster. Mr. Vines rejoined that time was not the only saving : every machine tool carried by sea arrived with the electrical equipment corroded.

The President of the Institution, Lord Halsbury, queried whether passengers would

* Chairman, British European Airways.
† Managing Director, Bristol Aircraft, Ltd.

object to the time " lost " by a really fast flight eastwards over the Atlantic. Mr. Masefield remarked that in all probability the best way to use a supersonic airliner was to fly westwards all the time : after arriving in New York, one would make a trans-continental flight, and then return over the Pacific. Another difficulty with supersonic airliners would be low utilisation due to the relative increase in loading, unloading, and taxying times : nevertheless, he believed that four aircraft making three round trips a day could handle the entire traffic. The limitations on stage speed would probably be noise and minimum altitude for going supersonic over inhabited territory.

On Friday morning Mr. S. P. Woodley, M.B.E., M.I.Prod.E.,‡ spoke of " The Impact on Other Industries." Subsequently Mr. M. Seaman observed that long-term planning, over periods of ten to fifteen years, was not possible for firms in the aircraft industry. Was it not desirable that bodies other than commercial, such as the professional institutions, be given a definite duty to the industry of studying future prospects and publishing their views, possibly through the existing Development Committee of the Federation of British Industries?

Mr. J. V. Connolly observed that a large portion of this country's scientific and technical manpower was locked up in work on aircraft and nuclear power : a reduced rate of progress in these activities might result in faster advances in other industries. In all cases the rate of advance was determined by the amount of money which could be expended on research, and where there was intense competition that amount was reduced. He expected that any staff leaving the aircraft industry would be readily absorbed elsewhere. Mr. Woodley differed, deeming it " suicide " to retard the development of the most advanced industries. It was more probable that other activities would be adopted by the aircraft industry than that the staff would move outside it.

Mr. R. L. Lickley considered that abstaining from supersonic commercial flight was equivalent to the decisions that had cost the shipbuilding industry its world eminence : the prestige coming from building the biggest and fastest craft might be indispensable. He did not feel that personnel from the aircraft industry would be welcome in established industries. Mr. Woodley recalled that the " Queen Mary " and " Queen Elizabeth " were built partly for prestige and partly to reduce unemployment. Supersonic airliners undertaken for the same reasons would, at the least, contribute much to the accumulated knowledge and experience.

Mr. D. L. Wiggins observed that when he had offered work to aircraft firms he had found that the prices were far higher than he was prepared to pay. Mr. Woodley suggested that this was because the overheads applied had included the upkeep of an aerodrome, wind tunnels, and other facilities not directly connected with the job. Mr. Masefield amplified this by pointing out that the Ministry of Supply would insist on paying no more for overheads than other customers, whatever the work involved : if the Ministry contracts involved heavy overheads, all other customers would have to be charged correspondingly heavily. Mr. Woodley remarked that the policy of the Ministry was demonstrably wrong, since the overheads were increased, not decreased, by refusing contracts. Mr. E. Turner pointed out that differential overheads had long been accepted by accountants.

‡ Director, Vickers-Armstrongs (Aircraft), Ltd.; General Manager, Supermarine Works.

The Open Forum

The chairman of the open forum on " The Importance of the Aircraft Industry in the National Economy " was Professor E. J. Richards : on the platform were Lord Douglas, Mr. Masefield, Mr. E. Turner, A.C.A.,§ and Mr. Woodley. We abstract the proceedings below : where the origin of a question is known it is given.

The final cost of an aircraft had been given as £14 per pound, and the raw materials were worth far less than this : could any other industry similarly multiply the value of material ? Mr. Masefield replied that materials were expensive, ranging up to beryllium at £300 an ounce : however, the most expensive contribution was that made by the brains of those responsible. Mr. Woodley said that the content of skill and knowledge was highest in nuclear engineering products.

Mr. W. S. Hollis : Is not the production engineer limited in his achievements by lack of research on the properties of metals, on electronics, on hydraulics and pneumatics, and other subjects ? Mr. Masefield : " Yes." Mr. Turner: " I agree." Mr. Woodley said that the fundamental research might well be done at the instigation of others than production engineers.

How would the industry to-day differ if the " Comet " failures had not occurred ? Lord Douglas believed that the failures had been tragic : as a result, it was only in turbo-prop. aircraft that this country was abreast of world progress. Mr. Turner agreed that the backlog of work would have been greater, but pointed out that the Boeing 707 and Douglas D.C.-8 would still have been much more attractive as economic propositions. Mr. Woodley felt that the pressure cabin failures had had some benefit in increasing basic research on fatigue—Lord Douglas observed that competitive manufacturers had been stimulated also. Mr. Masefield recorded that the fatigue failures caused the " Britannia " to be delayed two years performing tests which showed that it was satisfactory, and the sales of the aircraft were reduced thereby. Moreover, but for the " Comet " B.O.A.C. might have been ready to pioneer jet operations over the Atlantic. Mr. Turner added that these failures had caused both Government and public to think far less highly of the industry.

What of competition from the U.S.A. and the U.S.S.R. in the production and operation of commercial aircraft ? Lord Douglas expected to see Aeroflot extend its routes, probably to the United States of America ; the added competition would probably not be harmful. Their present and prospective aircraft were good, and held out promise of reducing fares. Mr. Masefield believed that Russian operators were commercially naive : certification by the airworthiness authorities of Great Britain and the United States of America would probably prove so difficult that their exports would be confined to such countries as India. However, it might well be that the Tu-114 would succeed in operating at fares lower than I.A.T.A. minima. Mr. Turner considered that there would be no market whatever for Russian aircraft, since the purchaser wanted, above all, to be assured of after-sales service, as he would not be in dealing with the national industry of U.S.S.R.

Did the platform foresee forced mergers between aircraft firms ? Mr. Turner : " Nonsense." Such a suggestion was " claptrap," attributable only to ignorant politicians. Mergers had no virtue unless a larger organisation was needed. An example of the misunderstanding of this topic was afforded when the Minister of Supply said that there would be less work for the aircraft industry and, in virtually the same breath, advocated the formation of bigger units. There was a " best " size of organisation to do any job, too large a firm being wasteful. He believed that the supersonic transport project was too large for any British aircraft company. Mr. Masefield agreed with the term " political claptrap " : he detected a foolish attempt to avoid any firms going out of business. Mergers for this motive would merely result in there being more administrators and fewer artisans, i.e. higher overheads. The reason existing firms did not have the capital to carry out the work in prospect was that that work was not attractive enough for them to raise fresh capital. Sub-contracting might remedy this, but it was certain that to spread the work geographically was inefficient. A merger might be the solution if it resulted in existing factories being shut down. Mr. Woodley, by analogy, deduced that to force a merger was to ensure its failure. Lord Douglas observed that the conclusion of a contract to supply the D.H.121 to British European Airways had been delayed months by the consummation of a merger.

In reply to a further question, Mr. Turner amplified his remarks by saying that a supersonic transport could not be built by a " partnership " of firms : there must be a prime contractor if the project was to be achieved.

Lord Douglas had recorded that B.E.A. made no profit on stages of less than 200 miles : is it not possible to do so ? Lord Douglas explained that a special short-haul aircraft might approach break-even, but the costs of handling passengers and the landing fees became dominant. Mr. Woodley could not accept this : it stood to reason that if there were more movements, landing fees would go down. Lord Douglas emphasised that such was not the policy of the Minister of Transport and Civil Aviation : B.E.A. had been refused any reduction in fees for more frequent landings. Mr. Masefield observed that the ability to fly to and from city centres was essential to make air travel substantially more attractive for short journeys.

Mr. S. Bentall asked whether the future of the aircraft industry might lie in " interdependence " with N.A.T.O., the Commonwealth, or the United States of America ? Mr. Masefield considered that N.A.T.O. could be ruled out, since decisions were never forthcoming rapidly enough in that assembly of many nations : he foresaw that the European Common Market might result in reduced demands for British aircraft. Collaboration with the United States of America might be invaluable. Lord Douglas related that British aircraft constructors had, in writing, urged him to include B.E.A. in the unified air line appearing on the Continent, in order that that line might have some British equipment. Since B.E.A. was the biggest carrier of traffic within Europe, he had most to lose in a combine, and as yet he had decided on no action. Mr. Woodley remarked that any international organisation was liable to be desperately slow and inefficient in decision-making : a strong and efficient industry always had a good chance of survival.

Was there a prospect for a heavy goods aircraft ? How should aircraft for users other than the nationalised Corporations be financed ? Mr. Masefield thought that Transport Command, Royal Air Force,

§ Chairman and Managing Director, Blackburn and General Aircraft, Ltd.

might well have a requirement for a heavy freighter. The design at present in hand, the Short "Britannic," appeared not to have been selected on its merits, and could not be expected to sell overseas. He believed that, as had sometimes occurred in the past, the Government should order prototypes and gamble on their commercial worth. Lord Douglas agreed that the Government might well sponsor new designs of aircraft. The freight aircraft was in a "chicken-and-egg" quandary, as only an aircraft too large for to-day's business could be cheap enough. Freight rates were not always commercially justifiable: some operators were carrying freight at a loss.

If, as Mr. Masefield had suggested, it was now possible for the engineer to make aircraft much faster or much cheaper than those in service, which would be preferable? Lord Douglas deemed it vital to enter the mass market, and wanted a low-fares aircraft. Mr. Masefield also wanted to see an aircraft of great productivity at low cost, but warned that great courage would be necessary to adopt it: it would mean a British operator, say B.O.A.C., using aircraft far slower than those of Pan American World Airways.

Technical Education

LAST week the Minister of Education, Mr. Geoffrey Lloyd, announced a new capital investment programme planned to cost £54,000,000 for technical education in the three years after 1961. In a circular to local education authorities, the Minister says that, in order to maintain the momentum of the advance in technical education, a building programme of £15,000,000 will be approved for 1961–62 and that the programmes for 1962–63 and 1963–64 will be provisionally set at the same figure. This total programme of £45,000,000 is expected to involve consequential expenditure of £9,000,000 on equipment. The circular reports that the £70,000,000 building programme for the five-year period covered by the 1956 White Paper up to 1961 is progressing steadily. Building projects under this plan for new colleges or major extensions now number 359, and in 1958 the value of work started amounted to £15,000,000. Local education authorities will now be able to continue to plan their building work two years in advance.

The new three-year programme will provide for further increases in the output of advanced students in science and technology beyond the level of 15,000 a year which the plans announced in the White Paper were designed to make possible; further expansion in educational provision for technicians and craftsmen to match the training opportunities which it is industry's task to provide for the growing number of young people who will be available for employment, and for improving existing facilities in the colleges not only for teaching but also for social and recreational purposes, including hostels. In the later two years of the programme it is proposed to give special priority to building proposals for commercial education.

RADIATOR VALVE.—A valve for hot water radiators now being made by Aerotaps, Ltd., Hudson's Drive, Cotteridge, Birmingham, 30, has a cast gun metal body fitted with a combined spindle and seating made of nylon. The design eliminates glands or stuffing-boxes, and there are no metal-to-metal seatings which can wear in service. Fitted between the combined nylon spindle and seating and the body of the valve is an "O" sealing ring of synthetic rubber and the water in the system provides a natural lubricant for the nylon. The valves are made in ½in and ¾in sizes and in straight and angle patterns.

Iron and Steel Engineers in the Netherlands

LAST week the Engineers' Group of the Iron and Steel Institute held a meeting in the Netherlands under the chairmanship of Mr. F. B. George. It was the first time that this group had held a meeting abroad and it turned out very successful. The invitation came from the Royal Netherlands Blast Furnaces and Steelworks, Ltd., and the members were also at other times guests of the Rotterdam Dry Dock Company, Ltd., and of the Müller-Hanna Company, Ltd. The main theme of the meeting which was centred on Amsterdam and which spread over four days was that of materials handling, especially of ore. Technical sessions occupied the members for the first two days, during which ten papers were read and discussed. Thereafter visits were made to the Royal Netherlands Blast Furnaces and Steelworks at Ijmuiden on Thursday, April 16, and to Rotterdam on the following day. The period of the visit having, we presume, been chosen with especial care, the opportunity was taken on the Thursday, after leaving the steel works to tour through the bulb fields and visit the really wonderful Keukenhof gardens near Lisse.

In due course the papers presented at the meeting and the discussions they evoked will be published in the Institute's *Proceedings*. Here, therefore, we intend to restrict comment to the visits. The main purpose of the visit to the steel works was to observe recently erected harbour facilities for handling ore and coal. The ore harbour is so situated that it can be reached by seagoing ships without having to pass through the great locks at the end of the North Sea Ship Canal which leads to Amsterdam. At low water there is a depth of 29ft alongside the quay which has an overall length of 1100ft. Here especial interest was taken by the members in two level-luffing cranes of 25 tons capacity, capable of unloading at rates averaging 400 tons per hour. These cranes were recently installed and they set up the problem that the ore bridge cranes spanning the stockyard behind them had smaller capacities for moving the ore. However, by quite simple modifications of their design, this problem was overcome. The three 12½-ton bridge cranes have an unloading capacity of 200 to 240 tons per hour. The Ijmuiden works is also noted for the existence there of a blast-furnace with a hearth diameter of 8·50m, not very far short of the largest in Europe. The opportunity was taken to inspect it. Also at Ijmuiden there is in successful operation a process of steelmaking originally developed in Austria in which oxygen is blown on to the surface of the molten iron. The process has many of the advantages of the Bessemer process; it is capable of handling ores unsuitable for Bessemer purposes; and it is characteristic of it that more pig iron and less scrap is needed than in the open hearth method. There are two convertors at Ijmuiden which are used alternatively for periods of about ten days: the output amounts to about 25,000 metric tons a month of crude steel.

The following morning the members of the party entrained for Rotterdam, where they embarked upon the M.S. "Erasmus," one of those small but many-decked ships which seem to be a speciality of that city and one especially designed for making tours of the harbour. Having two screws, she proved to be remarkedly manœuvrable in confined spaces. The ship travelled via the Waalhaven, where a sight was got of special cranes in coal-loading yards, to the yards of the Rotterdam Dry Dock Company, Ltd. There the members inspected a very fine new machine shop before passing on to watch a 6000-ton forging press in operation. In the forge they were also able to observe the forging of crankshafts. Each throw is forged in a single operation from a cylindrical shaft, the web being formed by an axial squeeze at the same time as the crank itself is pushed away by the downward stroke of the main press; a spectacular process. After lunching on board, the members went ashore to inspect the ore handling installation being constructed for the Müller-Hanna Company in the Botlek area of the port of Rotterdam, an area which has only begun to be developed since the war. Here that company is creating a vast stockyard which will eventually cover an area 700m long by 435m deep. There will be four 12-ton unloaders able to deliver ore at a rate of about 650 gross tons per hour directly to stock or to a system of conveyors serving the site. Three stackers and three reclaimers will deliver ore to, or reclaim it from, the yard at a rate for the former of 4000 tons per hour and for the latter, in 12-ton buckets, of 1100 gross tons per hour. There will also be a barge and ship-loading unit capable of loading ore as fast as the two unloaders or the reclaimers are likely to be able to supply it. At the time of the visit none of the plant was in service; but part of the conveyor system, one of the unloaders, a stacker and the barge loader, were operated for a short while transferring coal from one pile to another. Members were duly impressed by the size and capacity of the units of plant and even more so by the rate at which the conveyor belts are designed to run.

But though the members of the party were duly impressed by this stockyard, what impressed them still more as they sailed through Rotterdam's port was the evidence of prosperity. New plant, engineering shops, shipyards, stockyards, oil storage, oil refineries and equipment of all kinds are in evidence everywhere. Shipyards looked uniformly busy—amongst ships fitting out they saw the S.S. "Rotterdam," due for completion before the end of the year. With mixed feelings they noted certain British ships in Dutch yards undergoing repairs, presumably because costs would have been higher at home. There was very little evidence anywhere of recession. Rotterdam, of course, is ideally sited to become one of the world's great ports. It faces out upon the North Sea and the Channel to draw traffic from Scandinavia and the Baltic as well as from the world's oceans. In that respect it is, however, no more favourably situated than certain British ports. But it is also situated just where those two great European rivers, the Rhine and the Meuse, run into the sea. To watch the barge and other traffic moving on the river past the centre of Rotterdam so thickly as to remind the beholder of lorry traffic on a roadway, is to be brought to appreciate how great and how simply reached is the hinterland behind. That is where Rotterdam's advantage lies; the Dutch are grasping the opportunity with energy and avidity.

LETTERS AND LITERATURE

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

FAIRLIE LOCOMOTIVES

SIR,—Your correspondent, Mr. N. Charlton, is mistaken in thinking that the Eritrean Railway used Fairlie type locomotives; from 1907 to 1958, when the diesel made its appearance, this 3ft 1⅜in gauge railway, with 1 in 28½ gradients and 230ft radius curves, used Mallet type tank locomotives almost exclusively on its main line and in all it has owned fifty-five at one time or another. They were all 0-4-4-0 and included fifteen Mallet simples and some with superheaters. The original three came from Maffei of Munich and all the rest were built by Italian firms or were assembled from parts of withdrawn engines at the works at Asmara.

The only break in the Mallet monopoly occurred in 1923, when five 0-8-0 tanks with Klein-Lindner trucks at each end were acquired; these engines did not take kindly to the curvature and did little work. Maybe the Fairlie type would have been suitable for the conditions, but its Mallet rival swept the field.

P. M. KALLA-BISHOP

London, N.W.11,
April 18, 1959.

OVERLAPPING OF BRITISH STANDARDS

SIR,—Your leader (April 3) on "Overlapping of British Standards," with particular reference to standards for prime movers, raises some interesting points. Because the characteristics of these machines vary so much as between, say, steam and hydraulic turbines, the B.S.I. believes that the detailed drafting of specifications must, of necessity, be left to each of the technical committees concerned. Nevertheless, we appreciate the need for co-ordination of standards. For example, a committee is already drafting a standard to cover the measurement of electrical power and energy for the acceptance testing of electrical generating plant. Consideration is being given as to whether a similar step in relation to the measurement of certain mechanical quantities would be justifiable.

Your reference to I.C. engine-driven generating sets is, in point of fact, inaccurate. The suggestion that there should be a standard for I.C. engine-driven generating sets was considered by the two B.S.I. committees concerned (those on rotating electrical machinery and on I.C. engines), and there is thus no question of one of the committees not having been consulted. As yet no final decision has been taken on this matter—we are at present seeking the views of industry.

G. WESTON

Technical Director,
British Standards Institution,
2, Park Street, London, W.1,
April 14, 1959.

Book Reviews

Principles of Automatic Controls. By FLOYD E. NIXON. Macmillan and Co., Ltd., St. Martin's Street, London, W.C.2. Price 30s.

IT is usually evident from the contents and presentation of a book just what the background of the author has been and this is no exception. From start to finish it displays with abundant clarity a healthy practical background in which theory is not presented for its own sake, but as a tool in a logical design process. The author draws on a wealth of practical experience and illustrates his argument with well-chosen examples. At last a book has appeared which gets correct perspective on the position of automatic computing machinery in modern servo analysis and, if any criticism is to be made of this book, it is that non-linear systems are not discussed.

The first chapter is a general descriptive background introducing general terminology, and the second shows in a simple form how to go about writing, in mathematical form, the fundamental relationships existing in a mechanical or electrical system. This is a discipline which is very often omitted and the penalty is paid in full when a physical appreciation of a more complicated system is required. A chapter on Laplace transform follows and we feel that the author has struck a happy medium by not over-simplifying the theory yet delicately avoiding the deeper waters of contour integration. Some doubt is felt whether the Laplace transform coding system is of much use to the intelligent reader. The next chapter introduces the reader to the block diagram notation and the examples are particularly interesting to the aeronautical engineer. It is, however, somewhat irritating to find a well-presented argument summarised by a "rule of thumb." If the argument is understood by the reader the "rule of thumb" is superfluous and if it is not understood the "rule of thumb" is dangerous.

The fifth chapter begins to introduce the tools of the trade in terms of the Nyquist criterion, and the following one shows the application of the Nyquist criterion to typical open loop transfer functions. These chapters are a conventional presentation and are similar to what can be found in the vast majority of servo books. One annoying aspect is the author's confusion of the words "controllable" and "stable." An unstable system can be controllable and a stable system uncontrollable and these words are not interchangeable.

Going on from here, the seventh chapter introduces considerations necessary in design leading up to the necessary concepts of phase and gain relationships. A laboratory procedure is given for measuring frequency response, although this might be considered a little out of place in this particular chapter. The book goes on to consider methods of analysing open loop functions describing the popular log-decibel and phase loci plots and paying more attention than is usual in such books to the Evans Root Locus method. It was felt that insufficient emphasis was put on the amount of computation sometimes involved in obtaining these various plots, and one must be quite clear on the exact use they are being put to before embarking on such a study.

The next two chapters give an excellent account of the introductory steps in system synthesis, a subject very often left scrupulously alone by books of this kind. Here one eye is kept firmly on the final transient result and it is in these chapters that the author's experience is seen to best advantage. If only non-linear systems had been considered!

Chapter XI is devoted to a discussion on the interpretation of the Nyquist loci and the student is shown adequate evidence that there is more point in getting the "feel" of a physical system than in obtaining sometimes baffling curves which need a considerable background of experience before interpretation can be attempted. This is followed by an unusual and very refreshing chapter on numerical integration. The practical engineer will always realise that when he comes to the end of his ingenuity there is nothing to do but plot the transient response and examine the system transients. Numerical integration especially with non-linear systems is often the last resort, but only the practical as opposed to the theoretical servo engineer would consider including it in a book of this kind. The statement that fifty points per cycle of the highest system frequency are necessary seems highly exaggerated, at least for desk computation.

The contribution of automatic computing machinery to servo analysis is now very real and fast replacing many of the analytical methods, but is seldom considered in books such as this. It is thus refreshing to see this subject put in a correct perspective. Whether it was wise to discuss the operation of a digital computer is open to question, and we feel that it might have been better to look on a digital computer as a tool to which the servo engineer sent his problems, and an analogue computer as a tool on which he solved his problems; hence, he requires a much more intimate knowledge of the latter.

The biggest disappointment in the book is the very inadequate treatment meted out to non-linear systems in the final chapter. The author pleads that this is a separate subject, and so it is, but all the ingredients are available for an adequate discussion, and with the major tool in non-linear system analysis, the analogue computer, already discussed, much more justice could be done to the subject than a seven-page afterthought.

This is, taking it all round, an excellent book, and at last we find an engineer with considerable practical experience of both analytical servo theory and computer methods getting the two approaches in reasonable perspective. May we hope that at some future date this or some other engineer does a similar job for the expanding knowledge on non-linear system analysis.

An Outline of Photogrammetry. By K. SCHWIDEFSKY (translated by John Fosberry). Sir Isaac Pitman and Sons, Ltd., Parker Street, London, W.C.2. Price 60s.

THIS is a comprehensive volume dealing with the theory and practice of both terrestial and aerial photogrammetry as methods of surveying and includes both the procedure of obtaining the essential photographs and the subsequent plotting therefrom of maps and plans.

The book starts, in traditional fashion, by

giving a brief historical review of the subject and it may not be generally realised that photographic methods of surveying date as far back as the middle of the nineteenth century. The mathematical principles of photogrammetry are discussed, but this part of the book will not be readily understood without some prior knowledge of projective geometry. Optical theory then follows and is supplemented with full technical details of lenses and photographic equipment. Stereoscopic viewing of pairs of pictures is dealt with and a well-chosen example, printed in slightly out-of-register red and blue, in the familiar fashion, is very effective when viewed through the appropriately coloured celluloid eye-pieces supplied with the book.

Terrestial photo-surveying is described but no mention is made of the Bridges-Lee photo-theodolite which was an excellent instrument of practical use in certain kinds of country. Its possibilities, however, were never fully exploited. Reference is made to the stereocomparator and very complete details are given, in useful tabulated form, of modern photographic equipment for aerial surveying. Mention is made of the large nine-lens camera used by the U.S. Coast and Geodetic Survey and this section of the book is extended to include a description of flying techniques. Methods of plotting are discussed at some length and range from the use of the simple mirror stereoscope to the complicated, fully mechanised forms of plotting machines. The rectification of photographs with reference to "pass" or control points on the ground is explained. Some interesting notes are given of the applications of aerial photogrammetry, particularly the use of "close-ups" taken from relatively low altitudes for obtaining plans of large buildings and data concerning traffic flow and a wide variety of research investigations.

Plotting from mosaics and the computation of heights from both vertical and oblique photographs are given detailed consideration and working procedures used in various countries are described. In connection with aerial triangulation, mention is made of the Ordnance Survey method of revising the 1 : 2500 maps, in which the co-ordinates of the triangulation points are obtained wholly analytically by sequence-controlled computers. A useful chapter is devoted to accuracy and costs and it might be added that the wide use of air survey in preparing large-scale plans for such authorities as British Railways and the Ministry of Transport is a good indication that this method has economic advantages.

Although the photo-theodolite was never a popular instrument in British surveying practice, civil engineers in this country are fully aware of the possibilities and advantages of air survey, but the actual production of maps and plans by this process is confined to a limited number of specialist firms whose work is justifiably accepted as reliable.

The intricacies of photogrammetry are thus a little outside the province of the busy executive engineer whose main concern is the accuracy of the end product, but this book, with its very thorough treatment of every facet of the subject, will enlighten those who wish to extend their knowledge of the methods and equipment used. It should also be distinctly useful to geodetic surveyors and to scientific workers of all kinds who are engaged in studying the natural features and resources of unmapped and under-developed territories by aerial photography. The translator has produced a very readable English edition of the German original.

Engineering Systems Analysis. By ROBERT L. SUTHERLAND. Academic Books, Ltd., 129, Queensway, London, W.2. Price 60s.

THE author of this book is a Professor of Mechanical Engineering in the State University of Ohio, U.S.A. He had many years of experience in industry before returning to academic work. This book is basically a collection of the main subjects with which an undergraduate would be concerned in studying engineering systems and it does provide very useful sets of problems at the end of each section as well as the usual references. The answers to the problems are listed at the end of the book. The reader would need technical knowledge of the standard one would expect towards the end of an undergraduate's course in engineering.

Professor Sutherland has, by the use of analogies, shown that the problems involved in one form of engineering system can, through their mathematical description, be used to solve problems in other branches of engineering. Although this has been done before, it has normally been limited to showing the similarity between mechanical and electrical systems. In this book the scope is widened to include the field of acoustics. The dynamic analogies of resonance in these three kinds of systems are analysed in some detail. A point is finally reached where the reader will find it possible to consider the problems involving mixtures of these systems. In the final chapter the analogue computing machines are discussed and are shown to be merely a complex form of the analogies discussed in the earlier chapters of the book.

The principles of feed-back, dimensional analysis and computing machines described in the book are, of course, independent and important topics. Their treatment in this book, however, does provide enough stimulation for the reader to encourage him to continue studying any one of these techniques which may be of more immediate interest to him. The book is clearly laid out and well illustrated with diagrams. The mathematics used throughout the book are comparatively straightforward and should not worry anyone who is reaching the later stages of an engineering degree course. It is regrettable that the price of the book will put it outside the range of the average student in this country.

Books Received

Forest Machinery. By E. R. Huggard and T. H. Owen. Adam and Charles Black, 4–6, Soho Square, London, W.1. Price 24s.

Principles of Transistor Circuits. By S. W. Amos. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 21s.

Statistical Quality Control. By D. H. W. Allan. Chapman and Hall, Ltd., 37, Essex Street, Strand, London, W.C.2. Price 28s.

Aircraft Electrical Engineering. Edited by G. Wakefield. Chapman and Hall, Ltd., 37, Essex Street, Strand, London, W.C.2. Price 50s.

The Directory of Opportunities for School Leavers 1959. Cornmarket Press, Ltd., Darley House, 1, Lower James Street, London, W.1. Price 8s. 6d.

Civil Engineering Contracts Organisation. By J. C. Maxwell-Cook. Cleaver-Hume Press, Ltd., 31, Wright's Lane, London, W.8. Price 22s. 6d.

Physical Laws and Effects. By C. F. Hix Jr., and R. P. Alley. Chapman and Hall, Ltd., 37, Essex Street, Strand, London, W.C.2. Price 64s.

Watch and Clock Yearbook 1959. Edited by E. M. Bruton. N.A.G. Press, Ltd., 226, Latymer Court, Hammersmith, London, W.6. Price 3s. 6d.

Werstückspanner (Vorrichtungen). Second edition. By K. Schreyer. Springer-Verlag, Berlin-Wilmersdorf, Heidelberger Platz 3, German Federal Republic. Price DM.38.40.

The Structure and Properties of Porous Materials. Edited by A. D. H. Everett and F. S. Stone. Butterworth's Scientific Publications, 4 and 5, Bell Yard, London, W.C.2. Price 60s.

Obituary

A. P. CHALKLEY, B.Sc.

MARINE engineers and especially those concerned with the production and operation of oil engines will have learned with great regret of the death of Alfred Philip Chalkley, who died in London on Sunday, April 19. With his death the technical press has lost one of its most distinguished and respected members and one who had been associated with the publication of technical journals for forty-seven years. A. P. Chalkley, who was born in 1886, graduated at King's College, University of London (Faculty of Engineering), taking his B.Sc. (Engineering) degree in 1905, subsequently joining C. A. Parsons and Co., Ltd., at Newcastle upon Tyne.

There he was concerned with the development of steam turbines and was one of the company's guarantee engineers on the maiden voyage of the first "Mauretania." He became greatly interested in the development of the internal combustion engine, a form of engine with which he was to be closely associated during the rest of his life, and in those early days spent some time in Munich in collaboration with Dr. Rudolph Diesel.

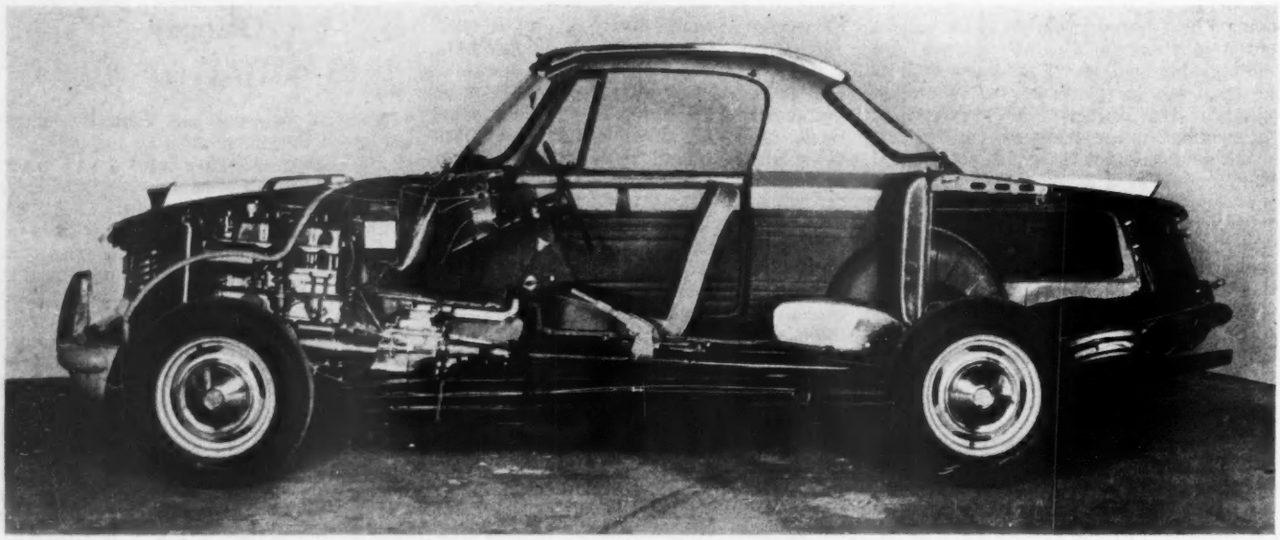
His work in this form of prime mover provided the material for a book, entitled *Diesel Engines for Land and Marine Work*, which was published in 1912 and which subsequently became a standard work on the subject, and was translated into French, German and Russian. This venture into authorship also marked the beginning of his long association with the technical press, for in the same year he joined the staff of Temple Press, Ltd., and was appointed editor of *Motor Boat and Yachting*, a position which he continued to occupy until 1955. In 1933 he became the founder editor of *The Oil Engine and Gas Turbine*, but perhaps the journal with which he was most closely associated in the minds of his many friends is *The Motor Ship*, which he founded in 1920 and through the medium of which he supported the development and employment of the oil engine.

Mr. Chalkley was appointed editorial director in 1944 and continued actively to occupy this position until his death, and to be responsible, in particular, for *The Motor Ship*.

I. V. ROBINSON

WE have learned with regret of the death of Mr. Isaac Vincent Robinson, which occurred at his home at Walton-on-Thames on April 16. Mr. Robinson, who was eighty, will be remembered by many engineers for his work as head of the power plant department of the British Electrical and Allied Manufacturers Association. He joined BEAMA in 1919 and continued actively in its affairs until his retirement only four years ago.

Mr. Robinson received his early engineering training at the Central Marine Engine Works, West Hartlepool, studied subsequently at the Royal College of Science, and thereafter spent several years in the steam turbine department of Richardsons, Westgarth and Co., Ltd. Mr. Robinson was a member of the Institution of Civil Engineers and of the Institution of Mechanical Engineers. He was also a Whitworth Exhibitioner and served as president of the Whitworth Society in 1948.



Front-engine, Rear-drive Light Car

The Triumph "Herald" uses the established 948 c.c. Standard engine in a back-bone chassis with independent suspension. The adoption of a new universal joint which is packed when new with sufficient lubricant to last throughout its service life has allowed the car to be designed for servicing at intervals of 12,000 miles or twelve months. The cost of accident repairs also should be reduced by the construction of the body in sections which are bolted to each other and the frame: six out of seven body sections are common to both saloon and fixed head coupé. There are no separate bumpers, the outermost parts of the panelwork being designed for ready repair or replacement. The wheel geometry changes with load, but the effect of this on handling has been suppressed by making the car very stable.

A NEW motor-car recently introduced by the Standard Motor Company, Ltd., the Triumph "Herald," has among its design objectives redressing the increase in the cost of upkeep compared to the cost of original manufacture that has occurred in recent years. The new car is not, therefore, of integral construction, but has a backbone frame on to which the sections of the body are bolted. In addition, those parts of the body which, in the absence of bumpers, are most likely to suffer damage, are arranged to be accessible and can, if necessary, be removed by drilling out the spot welds securing them. Routine servicing as well as accident repair is expected to be less costly, since the schedule calls only for checking of oil levels at 3000-mile intervals up to 12,000 miles: then, or yearly, the front hubs are recharged with grease and hypoid oil is injected into holes, normally blocked by screwed plugs, in six points—the two lower steering swivels, the two rear axle shaft outer bearings, the steering box and the water pump. There are two further departures from accepted British practice; the final drive is by universally jointed shafts and the rear suspension is independent, and the body was designed by Signor Giovanni Michelotti—the prototype bodies were in fact built by Vignale.

An interesting feature of the body is that the front wings and mudguards are assembled into one unit with the "bonnet" or panel over the engine bay, and the whole pivots about an axis low down at the front of the car (in fact, within the bulge that replaces the bumper) to give access to the power unit, front suspension, battery, and hydraulic reservoirs. This very large sheet steel structure with a virtually flat panel in the centre would naturally lack stiffness, and hence it is supported on a steel tube which begins and ends at the pivot points and extends well back over the engine. This part of the body can be removed completely without difficulty, the leads to the lights passing through two plug-and-socket joints. The lower front of the body includes the radiator grille and over-riders, and is bolted to the frame front cross-member.

The next of the body sub-assemblies is the scuttle and windscreen which carries the pendant pedals, steering column, plastics dashboard, and the hinges for the two doors. The winding windows in the doors have no frames, and work against very flexible rubber seals in the roof.

The largest part of the coachwork is the rear body, which includes the sills of the doors and also the lid of the luggage boot. It will be seen that the body ends in small fins above the rear lights: these are not necessary for stability, as will be explained below, but allow the rear wings to be formed by a simple folding action instead of a deep drawing. Below the lamps are chromed over-riders, but apart from these the plan of the tail is outlined by a convex skirt panel resembling a bumper. This panel is open at its lower edge, so that small dents can be hammered out, and if severely torn can be removed without disturbing the rear body by drilling through the spot welds: a replacement panel can then be bolted into place. (It is believed that the colours of the paints used can be controlled closely enough for body sections to be replaced without demanding a respray.) The lid of the luggage boot is, like the bonnet, stiffened by a steel tube: it props open automatically. The large flat panel on which the number plate is mounted is slightly recessed, so that a light in the top rear edge of the lid can illuminate both the plate and the inside of the boot. Under the floor of the boot is the spare wheel: it is considered that, tubeless tyres being used, it is unlikely that the wheel will be wanted when the car is loaded.

The remaining one of the seven body units is the roof. Two different roofs can be fitted, and naturally both intersect the rear deck sharply in the manner associated with Triumph cars: there is no suggestion of drag reduction in the body design. The roof of the saloon has fixed windows behind the doors and is high enough to allow two passengers to sit in the back: when the back of the bench seat provided is hinged down, the luggage boot is not divided from the rear of the cabin. The roof of the coupé has a rear window only: a seat for children can be provided below it, but even when the back is folded, the boot is not accessible from the cabin. This means that the reserve fuel supply can only be selected with the car stationary. It will be clear that the roof is virtually unstressed and, since there are no window frames, a detachable or "soft" top could be adopted without extensive redesign.

While describing the body, it may be appropriate to deal with the interior fittings. The two separate seats in the front are adjustable fore and aft when occupied: two alternative pivots, one above the other, allow the height to be altered, and the rake can be set at the rear support point. This support consists of a rubber block fitting round the tubular bottom member of the seat, and can be turned so that different depths of rubber come under the tube. An unusual provision is a tray of polythene-coated wire mesh under the dashboard, held up by a spring catch, which can be used for maps and other small items. Except for the windscreen washer pump on the off side, the minor controls are located in the middle of the dashboard, so that there is no temptation to reach them through the steering wheel. Under the steering wheel are two levers with three positions each: one selects left-off-right for the turning indicators, and the other parking-driving-meeting for the lamps when switched on by the panel switch. The inscriptions for both are diagrammatic so that they apply irrespective of the language of the driver. The steering column consists of a tube to which the wheel is attached and a rod with a flat on it extending to the steering box; the two are clamped together by a screw torqued to such a figure that, in case of an accident,

the column will collapse rather than injure the driver. A most unusual control is the accelerator : the throttle cable runs vertically through the cabin from floor to scuttle, and movement of the accelerator deflects it from straightness. It can be visualised that this will give a progressive decrease in sensitivity as the throttle opens, as is, of course, desirable, but the accelerator is so light as to feel floppy. A small complement of instruments consists essentially of a 100 m.p.h. speedometer with various warning lights : a water temperature indicator is optional on the saloon and standard on the coupé. A fuel contents gauge is calibrated $\frac{1}{4}$ – $\frac{1}{2}$ – $\frac{3}{4}$ – full : the mounting of the fuel tank with its major axis vertical renders the gauge, we are advised, extremely accurate.

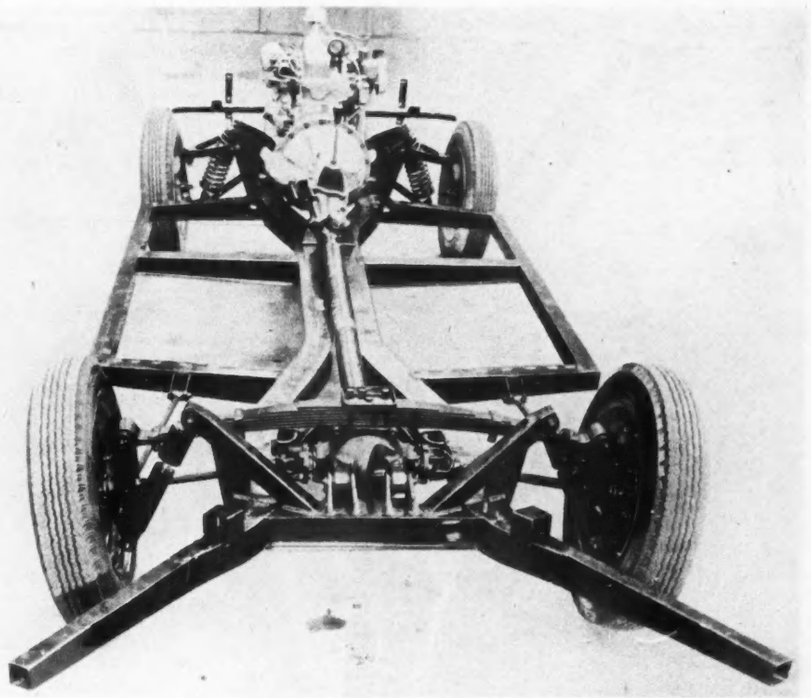
Frame and Suspension

The body is mounted on a frame such as has seldom been used in this country, a pair of boxed side members being secured close together in way of the cabin and separating at the front, to embrace the power unit, and at the back, to carry the final drive and the rear body. At the front there is a cross member to take the front suspension loads and another, a long tube, to support the front of the body : the latter acts as a "crash bar" to carry impact loads to the main masses in the event of an accident damaging the front of the car badly.

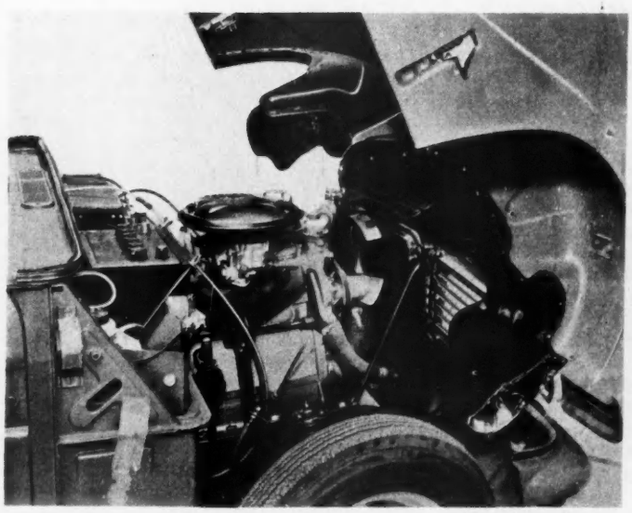
The propeller shaft runs above the frame members, causing there to be a shallow bulge in the centre of the floor. The shaft has Hardy Spicer couplings of a newly introduced design, which are packed with grease and sealed at manufacture and thereafter need no maintenance. Since these couplings are new, reliable statistical information as to the variations to be expected about the normal life is not available, and, hence, joints one size larger than on the Standard Ten are used to ensure a life adequate for the car.

Common to the existing car are the rolling bearings and differential in the final drive. Suspension at the rear is by a transverse leaf spring, clamped to the final drive casing, but in contrast to Standard front suspensions the spring is high up: this does not mean, however, that the spring is not loaded in the plane of the leaves. Since Standard practice is to use semi-floating rear axles, a logical development has been to include universal joints immediately outboard of the final drive and employ swing axle suspension. Sealed universal joints being used on this car, the shafts run in the open and the joint acts as a suspension pivot : this is perhaps the most powerful car yet to use this arrangement, but the designers are confident that it will give no trouble, since the thrust loads imposed on the universal joint are no larger than those generated in a propeller shaft by malfunctioning of splined telescopic joints. The shafts are made separately from the joints : the mating splines are an interference fit and a pin forms an additional safeguard against their separating. At the outer ends, the shafts are supported by ball and needle roller bearings in a housing which is pivoted in the spring carrier : this additional pivot is cheaper than a self-aligning bearing, since the inner race for the needle rollers can be ground on the shaft (the ball bearing merely locates the housing axially). The spring carrier is located fore and aft by a longitudinal link to the frame which takes the braking and driving forces : the brake torques are taken by the spring. The wheels are secured to the extremities of the shafts. No adjustment for camber is provided : it is found that change during the life of the vehicle is experienced only with a defective spring. Bump and rebound stops are incorporated in the inclined telescopic dampers : in the event of a half-shaft breakage, the damper sets a limit to the sideways movement of the hub. One of the significant details of the design is that the final drive is attached to the frame by rubber mountings.

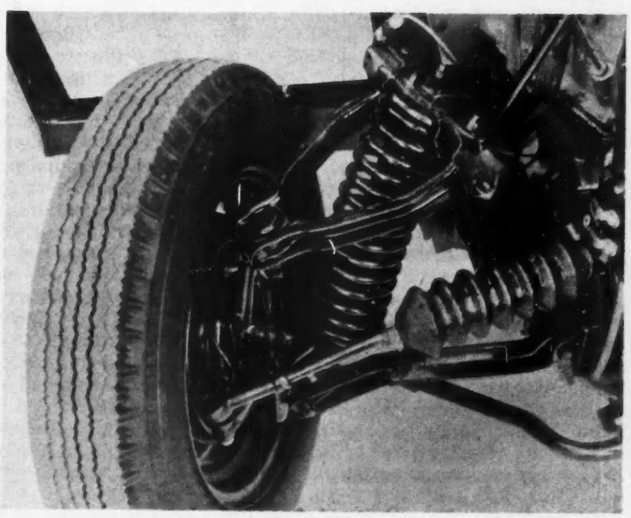
The front suspension is of conventional appearance : the separate steering pivots have now been eliminated, there being a ball joint at the outer end of the upper wishbone and a threaded bush pivoted to the lower wishbone, to which the spring and damper



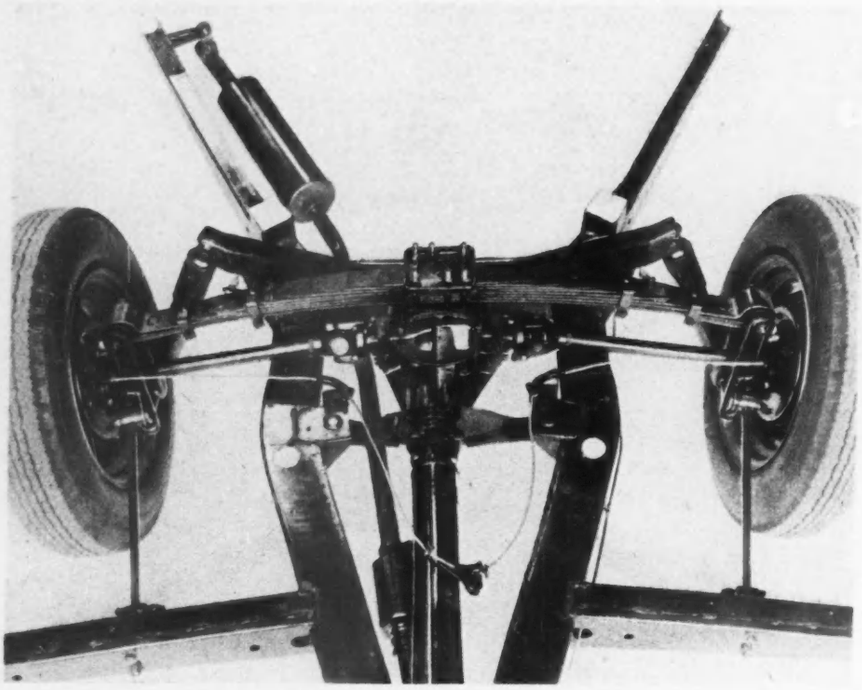
Two curved box-section longitudinals comprise the frame. The transverse leaf spring is not attached to the frame but to the rubber-mounted final drive, thus reducing the rear roll stiffness



Saloon car with bonnet open: notice that the mudguards lift with the wings. On the near side of the battery in this l.h.d. model are the screen washer tank and wiper motor. It can be seen that the inside of the protruding lower front panels is accessible



Wear resisting ball joints are used for the top steering pivots. The lower bearings are threaded and oil lubricated. Notice that the steering arm passes through a hole in the hub carrier. Spring and damper share the same mounting points



The sealed universal joints are an interference fit on the splined half shafts, and are also pinned. Notice that the parallel geometry of the members locating the bearing housing carrier allows cylindrical rubber bushes to be used on the trailing links. There is a small expansion chamber in the middle of the exhaust duct

are attached. This threaded bearing taking the road reactions of the front wheels is lubricated from its own oil reservoir : the lower wishbone has nylon pivots and the upper rubber bushes. A separate anti-roll bar increases the front roll stiffness.

It is possible at this stage to discuss the influence of the desired handling characteristics on the suspension design, although as the designers do not consider any of the accepted criteria meaningful no quantitative assessment of the handling has been made. It can be seen that the problem posed by the use of swing axle i.r.s. with a front engine is that the larger part of the disposable load is carried on the rear wheels, and therefore the handling characteristics may be expected to change with load : clearly, the well-known examples of swing axle geometry with rear engines are far less affected in this way, because the disposable load is further forward. The essence of the problem is that weight transfer causes an increase in the lateral stiffness when the camber is negative and a decrease when the camber is positive : the differential change of camber with roll is less intractable since the driver is aware of the roll. The solution adopted has been to minimise weight transfer : the rear roll centre has been lowered by skewing the pivot axes far from fore and aft, and the rear roll stiffness almost eliminated by including the rubber mountings of the final drive in the connection of spring to frame. Since roll must be controlled independently of suspension frequency, roll stiffness is added at the front. It is clear that this concentration of weight transfer at the front emphasises the tendency of wishbone i.f.s. to give a high positive static margin, i.e. an " under-steer " behaviour. Clearly it can be expected that, with torque reaction eliminated, it will not be possible to make the rear wheels break away. This great stability might impose heavy steering loads (75 per cent of the braking effort is applied to the front wheels) and a high steering gear efficiency is provided by a rack and pinion gear.

Power and Performance

The saloon and the coupé differ principally in the engines and final drive ratios. The saloon uses the existing Standard " Ten " engine with a remote control extension on the gearbox : the compression ratio is 8 : 1 and the net output 34½ h.p. at 4500 r.p.m., with a maximum b.m.e.p. of 125 lb per square inch at 2750 r.p.m. The coupé has a compression ratio of 8 : 5 and a b.m.e.p. of 128 lb per square inch at 3000 r.p.m. : twin carburettors are fitted, and the peak speed has risen to 5500 r.p.m. with an output of 42½ h.p. The two cars weigh, complete, 15¾ cwt and 15½ cwt respectively, and the final drive ratios are 4·875 and 4·55. The coupé thus runs at a significantly higher torque, and the fuel consumption figures reflect this : the manufacturer quotes, at constant road speed, figures for coupé and saloon as follows : 30 m.p.h., 52 and 48 m.p.g. ; 40 m.p.h., 47 and 42 m.p.g. ; 50 m.p.h., 41½ and 37 m.p.g. The claimed top gear acceleration figures are the same for both cars, fifteen seconds from 10 to 30 m.p.h., and sixteen seconds from 30 to 50 m.p.h., but the coupé can reach 50 m.p.h. in third and therefore shows a faster 0–50 m.p.h. figure, sixteen seconds instead of twenty seconds.

Both versions of the engine are attributed an oil consumption of about 3000 m.p.g.

General Data

Wheelbase	7ft 7½in
Track	4ft
Ground clearance, laden	6¼in
Turning circle	25ft
Length	12ft 9in
Width	5ft
Height	4ft 4in (saloon)
	4ft 3in (coupé)
Dry weight (initial production)	15 cwt (saloon)
	14¾ cwt (coupé)
Tyre size	5·20×13in (tubeless)
Gear ratios:	
First and reverse	4·271
Second	2·46
Third	1·454
Fourth	1·0

The Work of Coker and Filon in Photoelasticity

By Col. H. T. JESSOP

A jubilee commemoration of the original researches of Coker and Filon was held last week at University College, London. Colonel Jessop's lecture, which is reproduced here almost in full, was delivered on April 15. An exhibition of photoelasticity was also arranged, and technical lectures on " Modern aspects of photoelasticity " were given by Mr. C. Snell, as part of the commemoration.

IT is now fifty years since the late Professors E. G. Coker and L. N. G. Filon first met and began their collaboration in the development of photoelasticity. The collaboration extended over twenty-five years and resulted in the production of a method of experimental stress-analysis far in advance of anything hitherto available. The method had great potentialities for the improvement of engineering design, and as the work developed its originators had high hopes of its rapid adoption by industry. That these hopes were only partially fulfilled during their lifetime was due largely to the fact that at that time engineering knowledge and methods were not sufficiently advanced to be able to make use of the detailed information which photoelasticity could supply.

During the last twenty-five years, however, developments in engineering have taken place very rapidly, and have led to a very great change in the attitude of the engineering industry to scientific research. It is this change which has been mainly responsible for the constantly growing recognition in recent years of the value of Coker and Filon's work. The collaboration of the two men was in many ways a strange one, for they had practically nothing in common except their interest in photoelasticity—and even in this they approached the subject and all the problems it involved from widely different angles, and there were frequent clashes when the two paths led to conclusions which were not easily reconcilable.

Filon was by training a mathematician, but he had a wide range of abilities and interests and he had taken an Arts degree at University College, London, and had been awarded the gold medal for Greek. It was from Karl Pearson that he received his early training in Newtonian mechanics, astronomy and the mathematical theory of elasticity, the subjects which were to constitute his chief interests in later years. He was still keenly interested in elasticity, and had a great liking for experimental work, and while in Cambridge in 1901 he had carried out some experiments in which he used the stress-optical effect in glass to verify some of the results of the mathematical theory of elasticity. Later he developed a great

interest in the physics of the optical effect itself, and he continued to conduct a series of experimental investigations into the dispersion of the effect in glass and into the variation of the effect with temperature and chemical composition.

As an experimenter Filon showed great resource and ingenuity, and an amazing amount of patience. His methods were direct, and his apparatus was always extremely simple. Much of it was home-made, but he never seemed to grudge the time and labour involved in making adjustments and measurements with his improvised equipment. In fact the overcoming of such difficulties probably constituted for him the greatest attraction of this practical work. Filon therefore approached photoelasticity as a mathematician and physicist, his interest being almost entirely in the exploration and development of the theory of the subject, and in working out the basic experimental techniques.

Coker, on the other hand, was trained as an engineer, and his interest was almost exclusively in the applications of photoelasticity to engineering problems. He had started his career as an apprentice in the London and North Western railway works, obtained a National scholarship to the Royal College of Science, and from there a Whitworth scholarship to Edinburgh University. After taking an engineering degree, he entered the Patent Office as an assistant examiner, and while working there he studied at Cambridge for the Mechanical Sciences Tripos. In 1898 he was appointed associate professor of engineering at the McGill University, Montreal, returning to England in 1905 to become head of the engineering department of the Finsbury Technical College. It was here that he met Silvanus Thompson and became interested in the use of the stress-optical effect as a means of practical stress-analysis.

Coker had no special knowledge of either optics or mathematics, and the theory of photoelasticity was of interest to him only in so far as it provided the means of applying the optical method to stress-analysis. He regarded photoelasticity as a tool which could be of immediate use to engineers in resolving many of their design problems, and he hoped to produce methods and apparatus which could be used by engineers who had but slight knowledge of the theory.

Thus the two men had outlooks which were fundamentally different. To Filon it was inconceivable that anyone should embark upon such experimental investigations without a thorough study of all the principles involved. He feared that Coker's attempts to produce an apparatus which could be operated according to a set of instructions would put photoelasticity into the hands of unsuitable men, and he foresaw the many possibilities of error if the method were to be applied " by rule," as it well might be, to problems which were beyond its range. He also deplored the unknown factors which Coker introduced into his optical system in order to simplify the taking of observations. Coker, on the other hand, was convinced that engineers of his day would not be willing, or, in many cases, able to study the comparatively difficult mathematical theory, or to adopt the laborious techniques involved in direct observations of a model.

There was, of course, something to be said for both points of view. Experience showed that a much greater knowledge of theory was needed than that envisaged by Coker, even in investigations of the simple two-dimensional problems of that time. The method could not be made " fool-proof," and serious errors could only be avoided if the operator had a good understanding of both the mechanical and the optical conditions of his experiment. On the other hand, Coker was quite justified in his estimate of the engineers' point of view. Had it not been for his development of simple techniques, and his demonstrations of the application of the method to practical engineering problems, the stress-optical effect might well have remained for many years what it had already been for nearly a century—an interesting scientific curiosity suitable for investigation only in a physics research laboratory.

Perhaps the most remarkable feature of the collaboration was that it continued for so long without breaking down, for both men had very decided opinions, and both were inclined to be short-tempered. It appeared that in the end each began to appreciate to some extent the other's point of view, while their determination to complete the work led to a certain tolerance which somehow bridged the disagreements which occurred.

Eventually, in the preparation of their *Treatise on Photoelasticity*, Coker agreed reluctantly to the inclusion of much theory which he considered not only unnecessary, but likely to prove a stumbling block to engineers, while Filon agreed to the inclusion of many experimental details and results, the soundness of which appeared to him questionable.

The history of the beginning of Coker's work is not fully known. It appears fairly certain that it was Silvanus Thompson who first introduced him to the use of polarised light, for the first paper outlining the proposed method appeared under the names of Thompson and Coker. In their first paper Thompson and Coker made the assumptions that the stresses in a flat plate loaded in its mid-plane would be sensibly two-dimensional, and that all the two-dimensional equations of the mathematical theory could be applied to them. It was these assumptions which first brought Filon into the field, for he realised that they could not be strictly true, even in a thin plate, while the errors involved in adopting them for comparatively thick plates could only be assessed by a complete three-dimensional analysis of the stresses in such a plate.

Filon had already encountered this problem in a mathematical analysis he had carried out of the stresses in a bent rectangular beam. He now began a more general investigation which led to the formulation of his " theory of generalised plane stress." This work established a sound theoretical basis for the so-called " two-dimensional " photoelastic method.

In 1914, Coker and Filon presented a joint report to the British Association on the experimental determination of stress and strain in solids. They also published a joint paper on the stress distribution in short compression members. It may be noted that these were their only joint publications apart from their *Treatise on Photoelasticity*.

Coker came to University College in 1914 as Kennedy Professor of Engineering, but his arrival coincided with Filon's departure to France on war service. Filon was later recalled to a technical post at the Air Ministry, where he had little opportunity to continue photoelastic work. He did, however, during this period suggest, and take part in, a photoelastic investigation into the stresses in the wing-spars of a biplane. This was the first recorded application of photoelasticity to aircraft structures, and is worthy of notice in view of the fact that at the present time the aircraft industry is probably the largest user of photoelastic methods both in this country and abroad.

Filon had been appointed Goldsmid Professor of Applied Mathematics in 1912, and on his return to the College after the war he instituted a course of post-graduate lectures on photoelasticity, and established a small laboratory in which he and his assistants continued experimental work on the stress-optical effect. Coker meanwhile had established his laboratory in the engineering department, and proceeded to develop his practical techniques and to carry out a long series of stress-explorations assisted by a succession of post-graduate students who came to study the new method.

The published accounts of this work, and the lectures and demonstrations which Coker gave to various learned societies aroused great interest in academic and engineering circles and resulted in the establishment of a number of photoelastic research laboratories both in this country and abroad.

Filon's work was much less spectacular. In the realm of photoelasticity Filon was what would be termed to-day a " backroom boy," though perhaps many who knew him might find it difficult to visualise him in that role. Apart from his lectures, his photoelastic work was almost entirely on paper, and was carried out mainly during evenings and week-ends at his home. His experimental work was largely on the basic physics of the stress-optical effect, and he rarely embarked upon practical stress explorations. Most of his outstanding work on the theory of photoelasticity was unpublished until it appeared as a whole in the Treatise in 1931.

With the publication of the Treatise Filon felt that his work on photoelasticity was virtually completed. So far as could be seen at the time there was substantially nothing more that could be done in the development of the method itself, and that was his main interest in the subject. He did, however, undertake one more piece of work—the writing of a small *Manual of Photoelasticity for Engineers* which was published in 1936. The book had been planned as another joint work, but Coker's health was failing and he was unable to take part.

Filon was never quite sure whether he was acting rightly in thus encouraging engineers to enter the field of photoelasticity with what he considered quite inadequate knowledge of the subject ; but it had become clear that the full theory of the Treatise was too heavy for engineers as a whole, and that before long someone would try to produce something simpler. Filon feared that in other hands such simplification might result in reducing the operation of the method to a " rule of thumb " process, and it was this which persuaded him to produce the Manual.

The year following the publication of this book Filon contracted typhoid fever during the Croydon epidemic, and though he recovered from the disease he suffered a relapse and died of heart failure.

Coker had established a private photoelastic laboratory on his retirement from the College, and continued to do consulting work there, but his failing health forced him to close the laboratory in 1936. He died ten years later.

After Filon's death work in photoelasticity in England virtually ceased. No other institution in the country had taken up the subject seriously, and only the activities of a few enthusiasts who from time to time gave lectures and demonstrations to engineering societies kept interest in the method alive.

Several of the laboratories which had been established abroad, however, continued to do active work, improving the techniques of

the method as new apparatus and new photoelastic materials became available. It was in one of these laboratories that Oppel discovered in 1936 the "stress-freezing" property of one of the newly developed synthetic resins. It was this discovery which made possible the application of the photoelastic method to the exploration of three-dimensional stresses.

During the war years the development of three-dimensional applications continued in many places abroad, especially in the U.S.A. where it led to a greatly increased interest in photoelasticity. It was not until after the war that interest was re-awakened in this country, but it then spread rapidly, and increased steadily during the past fourteen years.

When we take stock of the work of Coker and Filon we cannot fail to be impressed by the completeness of thieir achievements. Filon's presentation of the theory of the subject covered the whole field of three-dimensional as well as two-dimensional stresses, and the methods of applying this theory to three-dimensional models to-day are but simple extensions of his methods.

The discovery of the stress-freezing process, in fact, stimulated a fresh demand for the Treatise, for no other text gave the full theory which was now required. The fact that a new edition of this book was needed in 1957 is an indication of the lasting value of Filon's work.

In the matter of apparatus and techniques there have, of course, been considerable advances. Even in two-dimensional work the discoveries of Polaroid filters, of high intensity sources, monochromatic light and of more sensitive photoelastic materials have inevitably led to new experimental methods, but in view of the resources available in his time, Coker's achievements in the development of practical techniques were remarkable. It is, in fact, true to say that practically all the advances in both methods and techniques since 1931 have only been made possible by developments of new apparatus and materials.

Of the value of Coker and Filon's work there can be no question. In addition to the major part they played in the development and teaching of the subject, Coker's practical stress explorations yielded much important information which was of immediate service to engineering, while in recent years the use of photoelasticity has produced an ever-increasing number of results of outstanding value to many branches of industry.

A very recent development has been its use in the investigation of the behaviour of actual structural materials, especially in connection with the problem of metal fatigue. It is this type of application which would undoubtedly have given the greatest satisfaction to the originators of the method, and it is in this field that one may expect to see valuable work done in the near future.

It has often been said that Coker and Filon laid the foundations of photoelasticity. They did much more than that. They built the whole structure substantially as it stands to-day. We who have followed them have, if I may continue the metaphor, been able to install a number of modern improvements. We may even have carried out one or two minor structural alterations, but the main fabric of the photoelastic method to-day is still basically that erected by the two pioneers.

If in the exhibition which has been arranged for this commemoration we have given some prominence to recent work, it is because we regard the modern achievements of photoelasticity as the direct results of the work of Coker and Filon.

British Railways 50 c/s Electrification

No. II—(*Concluded from page* 619, *April* 17)

Certain modifications of accepted British railway electrification practice are seen in the new 50 c/s electrification in Essex. In the following article some new equipment is described and details are given of signalling techniques necessary to immunise apparatus from interference by traction current.

CERTAIN items of electrical equipment in the multiple-unit trains now running on the Colchester–Clacton–Walton section of the Eastern Region are of designs also being supplied for other motor coach stock and locomotives ordered under the British Railways 25kV, 50 c/s, electrification programme. Two components in this category are seen in our illustration of the pantograph and circuit-breaker on the roof of a motor coach of one of the Colchester–Clacton–Walton four-car sets.

The circuit-breaker is the Brown Boveri DBTF air blast unit, the most recent development of the DBT breaker introduced in 1943. This has a breaking capacity of 250MVA at 25kV and 70 lb to 100 lb per square inch air pressure. Referring to the diagram, the circuit is first broken at the nozzle contact in the arc-extinction chamber *A*, after which isolator *B* is opened. Resistor *C* in parallel with the extinction chamber serves to reduce switching overvoltages. To open the breaker, valve *G* in control unit *F* is operated by a current impulse in its coil, which allows the spring *J* to open the orifice. This admits air to the right-hand side of main valve *L*, so allowing compressed air from reservoir *P* to enter the arc-extinction chamber, opening the nozzle contact and extinguishing the arc. Simultaneously air reaches the delayed-action valve *M*. This valve retards operation of the piston in cylinder *K* until the circuit has been broken and then admits air so that the piston, in moving to the right, rotates the isolator arm to the open position. Rotation of the isolator shaft actuates a cam in the control unit to reclose valve *G*, so that main valve *L* returns to the right, cutting off the air supply to the arc-extinction chamber and allowing the arcing contacts to reclose also.

On resetting the breaker, only the isolator operates. This is accomplished by energising magnet valve *H* so that air is admitted to the right-hand side of the piston, so returning the isolator arm to the position shown in the diagram. Auxiliary switch *N* is operated mechanically from the isolator shaft for controlling subsidiary circuits.

In the photograph reproduced of the motor coach roof the circuit-breaker is seen on the right with the arc-extinction chamber facing the camera. The unlagged steel dome of the air reservoir protrudes through the roof and transmits the external temperature to the air inside. This prevents the formation of moisture by condensation in the arc-extinction chamber and its supporting insulator. As an additional precaution the ventilation cartridge *Q* achieves the same object by spraying a continuous jet of expanded air of low relative humidity into the interior of the insulator.

The circuit-breaker serves not only for protection of the equipment, but also for interrupting and restoring current collection when passing between sections of overhead line fed at different voltages (25kV and 6·25kV). In these circumstances the operation is initiated by track inductors similar to those used for automatic train control.

Lightweight Pantograph

The pantograph illustrated is of the Faiveley design now being manufactured to British dimensions, and with certain modifications necessary for service on British Railways, by J. Stone and Co. (Deptford), Ltd. It can be seen that the form of construction reduces windage compared with a conventional pantograph framework, and is economical in space, this latter feature being particularly useful in a motor coach installation where room must be found both for the pantograph and circuit-breaker without encroaching on passenger space by lowering the roof over a large proportion of the body.

The lower arm of the pantograph is integral with a horizontal spindle turning in two bearings which are part of the base. A yoke at the end of the arm carries an upper framework consisting of two tubes cross-braced by a third tube at their upper ends. At the outer end of this framework a further tube is pivoted which carries the resilient mounting for the collector. An arm on this tube is controlled by a positioning link pivoted at its other end to the thrust rod which connects the yoke with the base and is pivoted at a fixed point on the latter. This rod ensures correct positioning of the upper frame as the lower arm rotates, while the positioning link maintains the contact plane horizontal during vertical movement.

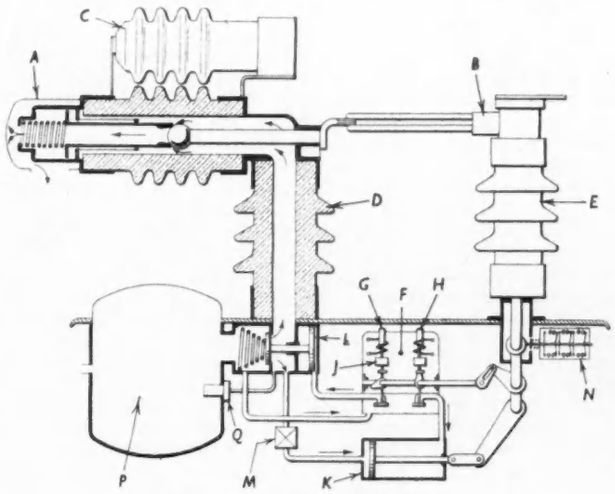
It was found that with the original pantograph the sideways tilting of the collector on its spring mountings could cause difficulty in restricted clearances by the lifting of one of its ends as the other was depressed by the contact wire. In the pantographs now in service on the Colchester–Clacton line, therefore, the collector is carried at each end on two rubber spring units which provide the necessary resilience while maintaining the collector substantially horizontal. The collector itself has carbon collector strips, and insulated horns of the type generally adopted for 25kV railway electrification.

The raising springs seen in the diagram raise the pantograph when air is admitted to the operating cylinder and the slotted link is displaced. When raised, the pantograph has free movement by reason of the slot to adapt itself to changes in contact wire height, and the fact that such movement takes place about only two bearings minimises friction and assists maintenance of contact.

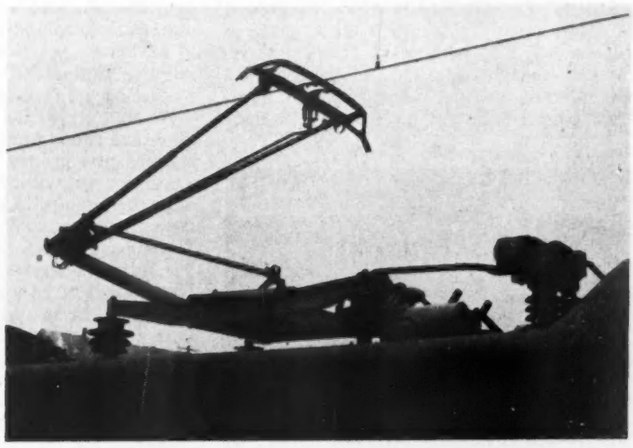
To lower the pantograph, air is exhausted from the cylinder, so that the piston returns under the action of its own spring and the upward movement of the link rotates the horizontal spindle in the reverse direction, lowering the pantograph and placing the raising springs under tension in readiness for the next operation. The weight of the complete pantograph and air motor is approximately 150 lb.

Signal Engineering

It had long been known that the use of high voltage a.c. would raise certain technical problems for the signal engineer, due to the possibility of interference with signal and



Mechanism of air-blast circuit-breaker



Lightweight pantograph and circuit-breaker (right) on motor coach

telecommunications circuits. It was with this in mind that soon after the announcement of the decision to use alternating current at 50 c/s for the traction supply for future electrification schemes, sites were chosen on the existing electrified lines which were suitable for use as testing grounds for signalling and telecommunications equipment operating under a.c. traction conditions.

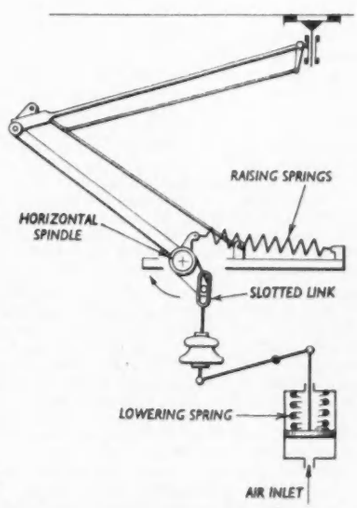
The Eastern Region Signal Engineer conducted a comprehensive series of tests during 1955 and 1956. These were divided into three main groups covering :

(*a*) The effects on the existing 50 c/s signalling equipment and cabling.

(*b*) The effects on standard telecommunications equipment and cabling.

(*c*) The effects on special " laboratory models " of signalling equipment designed following a study of the results of the tests conducted in (*a*) above.

Tests (*a*) and (*c*) were carried out on the Fenchurch Street–Bow Junction line, which normally operates at 1500V d.c. The d.c. feeds were removed and low voltage a.c. was applied through suitable control gear. The overhead line equipment was connected directly to the rails at the remote end of the test section, thus producing a return " traction current " in the rails which could be varied as required by adjusting the applied voltage. On another occasion, the 1500V d.c. feed was replaced by a 50 c/s supply at 6·25kV and running tests were carried out with a three-car multiple-unit train.



Principle of pantograph operation

In test series (*b*) a longer section was required and the line between Shenfield and Chelmsford was used. Alternating current at low voltage was applied at Hylands substation (near Chelmsford) and measurements were made in a cable termination building at Shenfield, giving a test exposure of about 7 miles.

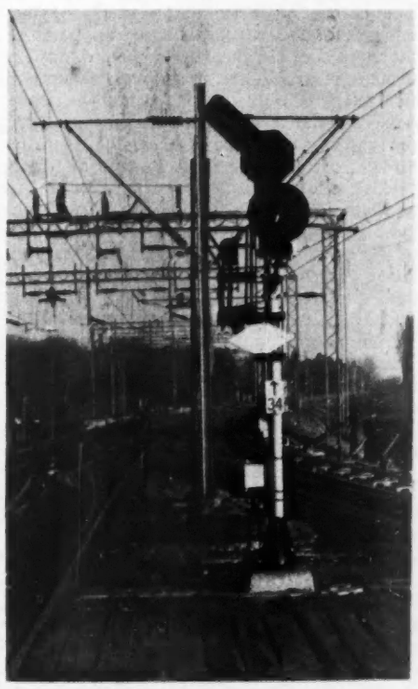
Three manufacturers of signalling equipment — Metropolitan-Vickers-GRS, Ltd., Siemens and General Electric Railway Signal Company, Ltd., and Westinghouse Brake and Signal Company, Ltd., together with a number of cable manufacturers, were present at the tests and each signalling equipment manufacturer produced " laboratory models " which were tested during the third series of tests.

Resulting from the information gained during the course of the tests, track circuits and other items of signalling equipment were designed for use in future 50 c/s a.c. traction areas. The tests also confirmed various theoretical deductions regarding the effect on the telecommunications cables and enabled cable requirements to be developed for future use.

The contract placed with Siemens and General Electric Railway Signal Company, Ltd., for resignalling on the Colchester–Clacton–Walton lines was the first for work of this kind to be allocated under the a.c. electrification programme, and in carrying it out the company has used some of the equipment designed in connection with the tests mentioned above. All the running lines from Colchester Junction to Clacton-on-Sea, including the branch to St. Botolphs, have been resignalled. Continuous track-circuiting and searchlight signals have been installed. Block working has been abolished, and the signalboxes at Hythe, Alresford, Thorington, Great Bentley and Weeley have been closed.

In this installation one running rail suffices for the traction return current, and so it has been possible to confine the signalling currents to the second rail, using single-rail d.c. track-circuits throughout. The design has been based on the necessity of ensuring that equipment will be immune from inductive or other effects of the 50 c/s current. All relays are d.c., and wherever the inherent impedance of equipment would be insufficient to ensure the exclusion of a.c., chokes have been provided, while track relays are further protected by a copper slug and magnetic shunt. The track-circuits are fed through transformer-rectifier units (except on the Walton branch) and in addition to reactor protection are provided with traction fuses and gas discharge surge arrestors at the feed and relay ends. No track-circuit appreciably exceeds 500 yards in length, and on the section at Alresford where the overhead line can be energised for test purposes at 6·25kV they are limited to 200 yards. No line circuits exceed 5 miles.

On the Walton branch the existing semaphore signals and battery-fed track-circuits have been retained, but the track-circuits have been divided as necessary to keep the length within the prescribed limit of 500 yards and most of the original electrical signalling equipment has been replaced by apparatus immune to 50 c/s current. The track-circuits on this branch between the passing loops at Kirby Cross and Frinton are normally de-energised, and are energised as part of the process of signalling a train in one direction or the other. The relays are " cascaded," that is to say, they pick up one after the other, beginning at the end of the section remote from that at which the train is to enter, and when all have picked up, the lock on the lever of the signal controlling entry is



Searchlight signal with direction route-indicator and subsidiary signal at Thorpe-le-Soken

released. The direction in which the process of "sweeping the tracks" takes place is governed by the operation of direction levers in the signalboxes. On this single-track branch the overhead line equipment masts have been erected on the side of the track

Searchlight signal with telephone at one of the level crossings on the route

remote from signals to give the best possible sighting conditions.

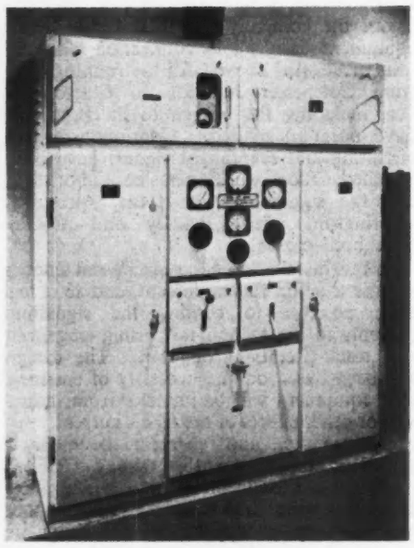
From Colchester to Thorpe-le-Soken and Clacton the searchlight signals show two or three aspects, and a fourth aspect is added, displayed by a separate single-light unit mounted above the searchlight, where required to achieve correct braking distance. The choice of searchlight signals for this scheme follows earlier practice on parts of the main line, but there are some grounds for selecting searchlights for a 50 c/s scheme in that there is only one lamp, automatically seen through a red spectacle, except when the signal is operated, and so there can be no risk of inductive or stray current effects causing a lamp in a less restrictive aspect to be illuminated. Earlier objections to searchlight signals on the grounds that replacement of the mechanisms involves akward manipulation of terminals from an access ladder have been removed by the development of plug-in units such as are used in this installation. Signals at junctions are equipped with five-lamp route indicators, as shown in one of the illustrations, and multi-lamp "theatre" type route-indicators are fitted to the home signals at Clacton (searchlight) and Walton (semaphore). At Thorpe-le-Soken the middle platform track has been signalled for working in both directions to facilitate the division and formation of trains running to and from the Clacton and Walton lines. The signals have 12V d.c. mechanisms with series chokes which provide additional immunity from a.c. On account of the combination of mechanism winding and choke, the operating voltage is 24V.

Subsidiary signals are position-lights except for four floodlit motor-operated disc signals at Clacton.

All main signals capable of showing a red light are equipped with telephones enabling motormen to communicate with the signalbox in advance. Most of these telephones have selective calling facilities and were supplied by Standard Telephones and Cables, Ltd.

At stations where signalboxes have been abolished and at three level crossings between stations new ground frames have been provided for gate and siding control. These have been equipped by S.G.E. with 12V d.c. lever locks immunised by series chokes. Two new ground frames with similar protection have taken over part of the work of Hythe signalbox (now closed). Other functions of this box have been transferred to East Gate. The signalboxes at Colchester Junction, East Gate, St. Botolphs, Wivenhoe, Thorpe-le-Soken, Clacton and Walton have been equipped with 24V d.c. combined lever locks and circuit controllers incorporating shading rings for immunity from a.c. interference. Existing lever locks at Kirby Cross and Frinton have been immunised by the provision of chokes.

Six point machines have been installed for operation of points remote from signalboxes, comprising three pairs of points controlled from East Gate and three crossovers controlled respectively from the boxes at Wivenhoe, Walton, and Clacton. These are combined machines (incorporating operation and detection in one straight-through assembly), and are equipped with track locks at the facing ends. The point motors operate on 110V d.c. from NIFE batteries, but the track locks are energised separately at the same voltage through transformer-rectifier units. Control of the points is effected through contactors with an overload circuit using thermistors to discriminate between transitory surges associated with the working cycle and sustained overloads such as might be caused by an obstruction. The thermistor and one winding of the overload relay are connected in series across a small line resistor. Normally, the voltage drop across the resistor is insufficient to operate the relay, but on a sustained overload the thermistor resistance falls sufficiently after four to six seconds for the relay to pick up and trip the contactor. In doing so, a holding circuit is made through a second winding of the relay to prevent the contactor from reclosing. There are similar, but separate, thermistor circuits for each direction of throwing the points, so that if the signalman, on seeing that the points have not thrown completely, reverses his lever, the contactor for driving the motor in the opposite direction closes without being affected by the thermistor circuit which has just operated, and which might cause a further trip because of the temperature of its thermistor.



One of the cubicle switchboards installed at signalboxes for controlling signalling power supplies

Provision is made for local hand-working of these power-operated points by means of crank handles housed in lineside cupboards. Normally, the handles are secured in the cupboards by a device adapted from a normal circuit controller with lever lock. Consequently, a handle can be removed only when a release has been given by a signalman.

Power supplies for signalling on the Colchester–Clacton line are taken from local sources at Colchester feeder station and Thorpe-le-Soken track sectioning cabin at 650V, 50 c/s, single-phase. In the event of the failure of either source, automatically operated contactors change over to a supply derived from the 25kV traction system. A cable route mainly in ground-level concrete troughing, but in places consisting of asbestos cement trough on posts 4ft 6in apart, carries the signalling power cable and the telecommunications cable. At each location connection is made with a 650/110V transformer housed, together with fuses and isolating links, in a termination case mounted on the side of the apparatus case. Plug-in relays have been used throughout in lineside apparatus cases and in signalboxes. On the Walton branch there is no 650V circuit, but supplies are taken from local sources supplemented by standby batteries. Signalboxes are equipped with cubicle switchboards for control and metering of incoming supplies. One of these boards is illustrated, and it will be seen that it brings signalling power supply practice into line with the growing industrial trend towards cubicle enclosures where previously individually mounted ironclad switchgear has been considered acceptable.

The telecommunications cables supplied by Pirelli-General Cable Works, Ltd., as subcontractor to S.G.E., are air-spaced, paper-insulated conductors having an aluminium sheath for screening, with two P.V.C. sheaths on the outside. Earthing of the aluminium sheath is provided at intervals of about 1000 yards.

The signalling work—with the exception of certain mechanical work, for which the appropriate railway departments were responsible—was carried out to the specification of Mr. R. A. Green, signal engineer, Eastern Region.

PLASTIC FINISH ON METAL PRODUCTS.—The Darlaston Galvanised Holloware Company, Ltd., Progress Works, Holyhead Road, Wednesbury, Staffs, has installed a plant for bonding many polythene and other types of plastic to ferrous or non-ferrous metal by the "Plasinter" process. With this process it is claimed that peeling of the plastic coating is eliminated and it is suitable for applying protective coatings to wire work, tubular steel assemblies, sheet metals, aluminium ware, brackets, castings, &c. The treatment protects the metals coated from corrosion; the coatings being non-toxic, capable of withstanding sterilisation in boiling water and having good electrical insulation properties.

NIAGARA FALLS FLOODLIGHTING FILM.—A 16mm optical and sound colour film with a running time of twenty minutes has been produced by The General Electric Company, Ltd., to show the design and installation of the company's floodlighting system brought into use at Niagara Falls last year. Aspects of the work covered by the film include the design of the projectors in the G.E.C. Research Laboratories at Wembley, site surveys at Niagara, and the erection of the units and control system at the Falls. Concluding scenes show the inauguration ceremony and the colour-change floodlighting in operation. The film is available on application to the Publicity Organisation, The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2.

Institution of Naval Architects

ANNUAL SPRING MEETING

No. IV—(*Continued from page 622, April 17*)

THE last paper presented on Thursday was :

A FURTHER STUDY OF SHIP LOSSES

By C. V. MANLEY

SYNOPSIS

The results of previous studies of ship casualties are brought up to date and the relationship of the casualties to the total tonnage studied in detail. Tables give numerical particulars of ship losses and a variety of relationships are established, in particular, with the number of ships at risk. Losses in relation to the total number of ships and gross tonnage owned are shown to have a steady downward trend.

DISCUSSION

Mr. J. Burton Davies : Mr. Manley's previous paper contained a comprehensive summary of ship casualties. I was one of those who suggested that the value of such papers would be considerably enhanced if information could be given regarding the number of ships at risk in the various size categories considered, and in the present paper he has gone to considerable trouble to provide this information.

There are two types of loss for which no estimate of ships at risk can be made. I refer to ships wrecked and to collision losses, figures for which are given. We find that approximately half of all these casualties are to vessels of 200ft and below, and this is probably natural, since these vessels spend the vast majority of their sea-going time in narrow confined waters where there is a far greater risk of this type of casualty as compared with the larger vessels, which spend most of their time in the wide empty oceans.

The author's graphs indicating the ships reported abandoned, foundered or missing, 1924–1957, show that when the total number of vessels at risk are considered, the relative number of casualties has remained practically constant over the past thirty years. This still shows that the smaller vessels are most likely to be in trouble ; but the taking into account of the numbers at risk does alter the picture.

Considering only the total number of casualties, some 80 per cent of the vessels concerned are under 300ft ; but, as a percentage of the total number at risk, this 80 per cent is far more like what one would have expected. Still the figure for small ships should not be minimised on this account, for it is shown that the vessel under 300ft is about twice as likely to be abandoned, to founder or to be missing as a vessel about 400ft long.

The other most noticeable point in the previous paper was the high proportion of new ships involved, and this, on the face of it, seemed a contradiction of what one would have expected.

The paper appears to dispose of the idea that a new ship is more likely to be lost than is an older vessel of the same size. Previously when referring to the numbers of ships at risk, Mr. Manley has made it plain that these do not include special types, but in this paper he has not made any mention of this when dividing vessels into age groups. Do his figures cover all vessels, or has he excluded the special types ?

Mr. Skinner : I want to concentrate on the ships abandoned, foundered or missing type of casualty. The figures show that in 1956–57 the ships over 400ft long which were so lost can be as low as 0·04 per cent of the total number at risk. The percentage for ships of 300ft–400ft length is double that figure, and for ships 200ft–300ft long it is more than three times; for ships less than 200ft long it is six and a half times. It seems to me that this result challenges naval architects to do something about it.

If we are searching for the factors which cause such losses, we want one which gives us a figure of something like 0·3 per cent of the total at risk. Using that as a criterion, you will see that age does not enter into the picture very much until the ships get very old.

Looking at the R.Q.D. group, they do show this figure of around 0·3 per cent of the total at risk ; also you can deduce from what is said in the paper that these ships are lost, not because they are R.Q.D. ships, but because they are small.

We might ask why we lose ships. They are lost because they carry cargo, and cargo affects stability. If you look at the curves for stability in the loaded condition, all these ships have very small ranges of stability ; and the range can be affected by the slightest list on leaving harbour. A slight list will have a disastrous effect on the range of stability of these ships. Moreover, range can be affected by lack of freeboard.

In the paper the author gives more information about ships which have capsized. From it you will find that nineteen out of eighty-three capsized because there was a shift of cargo. Considering the detail of this investigation, that is not a very large proportion, because one would have thought that, if a shift of cargo were the prime cause, more than nineteen out of eighty-three ships would have capsized from that cause. So that I suggest that another cause is operating at the same time—lack of freeboard in the first place.

It is incredible that small ships should have proportionately less freeboard than large ships, and are allowed to load deeper in relation to their size than any other craft ; and here is Mr. Manley demonstrating to us that the small ship is more vulnerable than the larger.

There are means by which, therefore, we can reduce these losses—increase the freeboard of these ships, increase the range, and give the ships a greater factor of safety than they had before. We have now the International Maritime Consultative Organisation, which was set up for the purpose of the interchange of views. Surely here is a case in which we in this country can take the lead and table some new proposals for the freeboard of small ships.

Professor C. W. Prohaska : Why do ships capsize ? It may be due to lack of stability or to their being wrongly handled. I ask that more information should be given to those who handle the ships, and that naval architects should look closely into the stability curves for these ships.

These curves show that low freeboard can be very dangerous. I saw recently the stability curve for a Danish coaster which capsized. She was rolling quite normally and we did not suspect that it would be possible for her to turn over. Although not a timber carrier she was carrying a timber cargo on deck. She was a small ship with a minimum of freeboard. Obviously there was no official requirement to supply stability curves and I stress the importance of supplying proper stability information to the captains of ships. They should certainly not be allowed to load deck cargo if they are not provided with stability curves, and such cargo should not be taken on board until it is proved that it can be done safely.

Mr. J. Lenaghan : Mr. Skinner and Professor Prohaska have asked for more freeboard for these small ships, and Professor Prohaska has illustrated an interesting stability curve. We had exactly the same feature in connection with some ships during the war ; they were small tankers, 140ft or 150ft long, and they had a very deep draught, with about 12in of freeboard. These ships were handled by inexperienced personnel. In certain conditions off the Normandy coast, with cross seas, they were inclined to list very heavily ; the water line came up to the edge of the deck, but the ships continued to list and some were lost. The information given to a master, particularly of a small ship, is important, and we must explain to masters just why they are given this information.

A table in the paper gives figures for losses by fire, and I wonder whether there has been an increase or decrease since the fire regulations were tightened up ; it would be interesting to know how effective the new regulations may be in preventing or putting out fires which otherwise would lead to casualties. Do the figures given for collision losses reflect any influence of the experience, or lack of experience, of their masters ?

Has the fitting of steel hatch covers had any influence in preventing casualties at sea, particularly in small ships ? There is a graph in the paper showing the trend of casualties during the three periods of revised load line regulations. The curve for ships over 400ft long is still going up, and the curve for ships of 200ft and below is going up considerably. I am not sure that it gives encouragement to relax these rules.

Mr. H. F. J. Higgs : Regarding common hazards of stranding, collision and loss by capsizing, or otherwise succumbing to the elements—I always feel that these losses are in no small measure due to the fact that the ships are operating in the more confined waters. Again, sometimes in the coasting trade, the quality of the personnel is not as it might be. I think we suffered from that particularly in the post-war period, and in periods of prosperity there have been less qualified men available.

If there is a trend for casualties to occur in the more modern ships it may be due in part to the fact that the modern coaster is, in the main, faster than its pre-war equivalent. That calls, without a shadow of doubt, for better judgment in handling ; furthermore, it leads to fatigue.

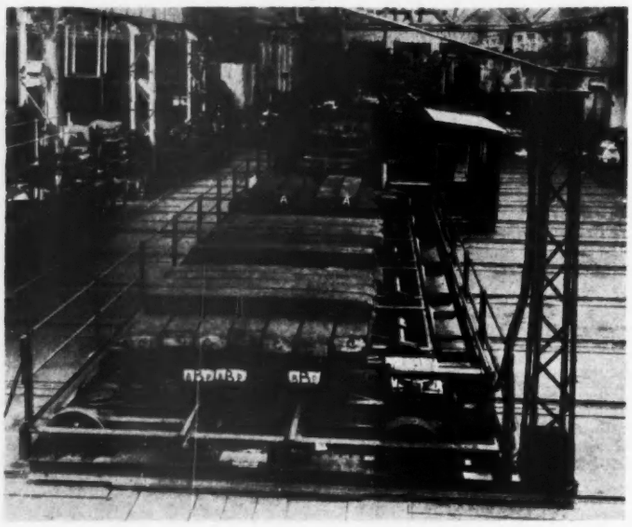
So that our need is for seaworthiness. From my own experience in small vessels I would stress the importance of freeboard and the complete integrity of superstructures.

The list at the end of the paper, giving more details of capsized ships, is of extreme value, and I would like to see it extended. If it is not too much to ask, I would suggest that from time to time we might have a survey of casualties in small ships, tempered with the findings of courts of inquiry.

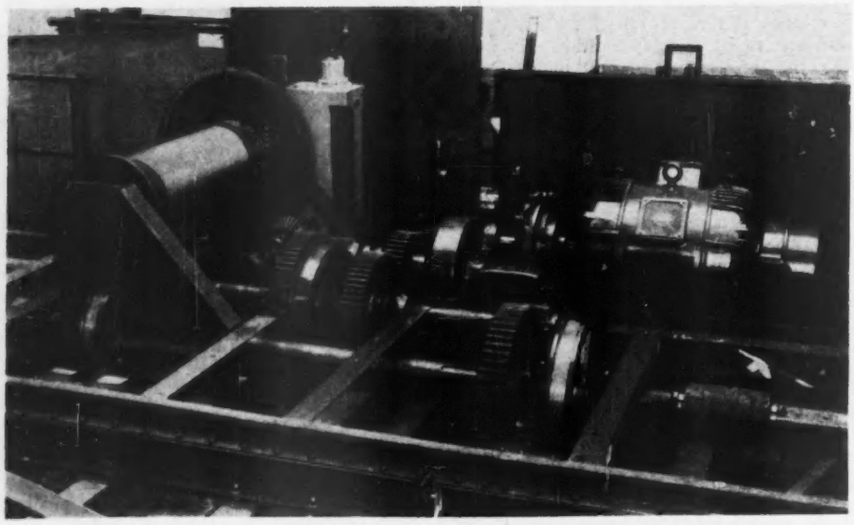
(*To be continued*)

Large Locomotive Traverser

The locomotive traverser illustrated on the right was recently completed at the works of S. H. Heywood and Co., Ltd., for installation at the Nairobi workshops of the East African Railways. The machine has an overall length of 100ft and, with its capacity for handling locomotives weighing up to 260 tons, it will be one of the largest traversers in railway service. It is driven by a 75 h.p. motor which is also used for winching locomotives on and off the table. The travelling speed is 200ft per minute unloaded and 100ft per minute when loaded, the hauling capacity of the winch being 3¼ tons at 150ft per minute.



Traverser under construction, showing the arrangement of the main frame members and the mounting of the travelling wheels in the double transverse girders



Driving machinery of traverser, in which dog clutches are used to select the drive to the winch or the main shaft

A TRAVERSER capable of handling locomotives weighing up to 260 tons has been built by S. H. Heywood and Co., Ltd., Reddish, Stockport, to the order of the Crown Agents for Overseas Governments and Administrations, for installation in the Nairobi workshops of the East African Railways and Harbour Board. This machine, with an overall length of 100ft, is believed to be one of the largest in the world, and will handle all locomotives on the system, including the heaviest and largest class "59" Beyer-Garratt engines in service on the East African Railways. The machine can be seen undergoing its acceptance tests at the makers' works in the photographs we reproduce, and for these tests it carried a 25 per cent overload which brought the total weight handled to 325 tons. At present its rails are set for metre gauge track, but provision has been made for moving the rails over to suit the 3ft 6in gauge which is being adopted on the system at a future date. In full working order, the traverser weighs over 50 tons.

The frame of the machine consists of an assembly of four main longitudinal girders attached by fitted bolts to thirteen pairs of transverse girders, the assembly being completed by cross bracing in the horizontal plane. The two outer longitudinal members are of triangulated design, with heavy top and bottom boom members connected by diagonal and vertical bracing. The two inner longitudinal members are rolled steel joists on which the rails are bolted. This frame has an overall length of 99ft 6in and an overall width of 14ft 8in.

The machine is carried on traverse rails set at 8ft 2in centres by thirteen pairs of cast steel, 2ft 2in diameter, double-flanged wheels. Each pair of these wheels is mounted in line between the two members of each transverse girder in the main frame. On one side of the machine the wheels are supported on short axles which run in phosphor bronze bearings in brackets mounted on top of each transverse frame member. On the other, driving, side of the machine, all thirteen wheels are keyed to the large diameter main driving shaft which runs the full length of the traverser. Provision is made for fitting boards over the top of the frame and an outboard walkway is provided along the driving shaft side.

The machinery of the traverser is grouped on a platform carried on a girder extension at the centre of the machine and it is enclosed in a steel frame cabin with boarded sides. The drive for all motions is supplied by a 75 h.p., 575 r.p.m., reversing motor for which

the current is taken from overhead cables by three collector arms mounted on a steel lattice tower at one end of the machine. An eight-notch controller of standard industrial reversing drum design is provided for the drive, there being a crane-type protective panel and a three-phase main contactor circuit breaker with overload protection. An adjustable relay is fitted with a time-lag device to allow a momentary peak without operating the main circuit breaker, which comes into immediate operation in the event of a short circuit or sustained overload on the machine.

The motor drives reduction gearing and a selector dog clutch shaft. Through two dog clutches on this shaft there can be selected either the main traverser drive, which is taken through spur gearing to the main shaft, or winch drive which is transmitted through spur and bevel gearing to the drum. The arrangement of the machinery can be seen in one of our illustrations. A solenoid operated brake is fitted on the motor shaft and a hand-lever operated friction brake on the winch.

This machinery is designed to drive the traverser at up to 100ft per minute when loaded and 200ft per minute when unloaded. The winch, which takes 200ft of 2½in circumference cable, has a hauling capacity of 3¼ tons at 150ft per minute. A heavy pedestal at each end of the main frame provides an anchor for a locomotive hauling cable return sheave.

As already mentioned, the whole of the main structure of the machine has been assembled using fitted bolts, and the design has been specially arranged for ready dismantling for transport and reassembly on site. The transverse girders, support members for the longitudinal rail bearing girders, were drilled during manufacture to suit the machine for quick conversion to handle 3ft 6in gauge locomotives when the new gauge is introduced by East African Railways.

Duston Mill Pumping Station

THE Duston Mill works of the Mid-Northamptonshire Water Board, comprising a completely automatic pumping station and a pipeline to an existing reservoir, were inaugurated by the Minister of Housing and Local Government, Mr. H. Brooke, on April 17. The occasion was also noteworthy as marking the completion of the first ten years of the Board's life.

Since the Ministry's policy of amalgamating small water undertakings is a topical subject of debate, it may be of interest to give some details of what has been achieved by the Mid-Northamptonshire Water Board in an area which has proved in the past to be a difficult one from the point of view of water supply. The Board was formed in 1949 by amalgamating the undertakings of fifteen local authorities and two water companies for the purpose of supplying some 275,000 people in an area of 500 square miles. This new Board inherited four impounding reservoirs, varying in capacity from 130 million to 454 million gallons, two river intakes, and fifty-eight wells or boreholes and springs, needing eighty-four pumping stations for their operation. Part of the area had no piped supply.

The Board also inherited statutory powers enabling it to construct a large impounding reservoir at Pitsford, together with filtration and pumping machinery. The Order which formed the Board gave powers for the construction of the Duston Mill intake works. The design and construction of the Pitsford reservoir were put in hand immediately and completed in 1956. A brief description of Pitsford reservoir was published in THE ENGINEER of November 9, 1956.

Four area distribution schemes were also put in hand and the whole area was thus integrated into one working unit as quickly as possible. Simultaneously the distribution districts were reorganised. As a trial the area was first divided into five districts, each with its little office for consumer contacts. Experience showed that these districts could be reduced to four in number. Whilst each district is self-supporting as regards distribution, but not sources of water, considerable help has been given by one district to another.

Since 1949, the Board has constructed: Pitsford reservoir, capacity 3·9 m.g.; Pitsford treatment, softening and pumping plants; sixteen service reservoirs in reinforced concrete with capacities varying from 0·05 to 5 m.g.; fourteen water towers with capacities from 10,000 gallons to 250,000 gallons and heights from 50ft to 115ft; eighteen repumping stations, containing altogether fifty-three electric or diesel pumps and three diesel alternators; 300 miles of water mains from 3in to 36in diameter. Thousands of new houses have been connected to the mains and hundreds of thousands of taps have been rewashered. Altogether the Board has spent, to the end of March, 1959, £4,900,000 on these works.

Consumption of water in the Board's limits has risen from 5½ m.g.d. in 1947 to 10¾ m.g.d at the present time.

DUSTON MILL WORKS

The works opened last week form the second and final instalment of the Board's major supply works. The first part consisted of the Pitsford reservoir with its associated treatment and filtration plant and pumping station. The reservoir alone can supply 4 m.g.d. in severe droughts. The Duston Mill works add another 4 m.g.d. in similar conditions. The filtration, treatment and pumping plant was designed to deal with 10 m.g.d.

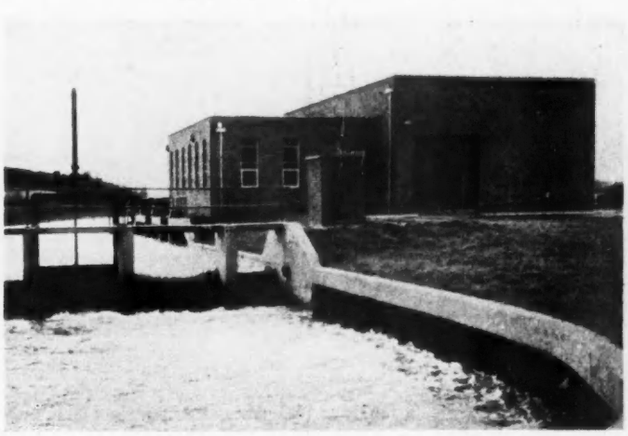
The Duston Mill works are, like Pitsford reservoir, within the catchment area of the River Nene, but are situated on a different branch of the river. They consist of an intake and coarse screens with pumping machinery and a 36in diameter main to lead raw water into Pitsford reservoir for storage. In this area there is very little underground water and the key to a satisfactory water supply is to store the winter rains against the dry times of most summers and some winters.

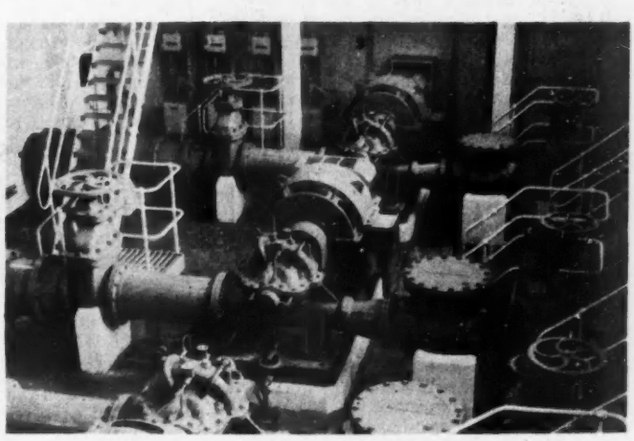
The works are entirely automatic in operation, being unattended except for occasional supervisory visits. The quantity of water abstracted from the river is controlled by maintaining the river at a constant level, when the flow is greater than 7·5 m.g.d., this being the statutory amount of compensation water, below which rate no abstraction is permitted. The old mill weir has been replaced by a new weir across the river and when the flow over this weir exceeds 7·5 m.g.d. the screens are started and their starting causes the 11,000V electricity supply to be switched on and, in turn, this sets the pumping machinery in motion. Thereafter the number of pumps in use, their speed and therefore the station output, is matched to the quantity of water available for extraction. The maximum rate of abstraction is 20 m.g.d.; when the river flow falls below 7·5 m.g.d. the station shuts down automatically. There are numerous interlocks and safety devices to ensure that the sequence of events is always the proper one and that any failure in part of the machinery causes some other part to take over the load. There are no stand-by pumps and no stand-by electricity supply. The stand-by is provided by the water stored in Pitsford reservoir.

The screens are rotating devices which are continuously washed to prevent choking. They are 2ft 6in wide and 10ft 6in diameter and at top speed they turn at a rate of one revolution in two minutes. The four pumps each need 280 b.h.p. at maximum output and are driven by d.c. motors at speeds varying from 1125 to 1620 r.p.m., as necessary. The current is provided by two germanium rectifiers, each having a capacity of 480kW.

Water from the pumps is conveyed to Pitsford through a 36in diameter main, partly constructed in welded steel and partly in prestressed concrete, with a total length of about 7 miles. The pipeline passes through the end of the Pitsford dam remote from the treatment works and is led some 300 yards up the side of the reservoir and discharged over a series of stepped weirs, thus securing an adequate mixing of the Duston water with that already in the reservoir, and also aerating it to reduce the bacterial content. If experience proves it to be necessary, this raw water will be chlorinated at Duston Mill.

The Duston Mill works have cost about £350,000 to construct. They have been built to the designs of the Board's chief engineer, Mr. L. H. Brown, M.I.C.E.





(Left) Duston Mill weir and pumping station. (Right) The pump room, showing pumps and controllers

SHORTER REPORTS

National Engineering Laboratory

THE Council for Scientific and Industrial Research has announced that the Mechanical Engineering Research Laboratory at East Kilbride, near Glasgow, will in future be known as the National Engineering Laboratory. This change of title has been made because the Council considers it desirable to emphasise the national character of the laboratory which is part of the D.S.I.R. organisation and is financed from public funds. It does not imply any change in the field covered by the laboratory, which will continue to be concerned with problems of mechanical engineering. The Council has also decided to set up a steering committee to look after the programme of the laboratory. As a result of a recent review of the functions and activities of the laboratory, the Council is convinced that, between the proper and reasonable activities of the universities and technical colleges on the one hand and research associations and private and nationalised industry on the other, there is an important place for a national establishment for research in mechanical engineering, mainly supported by public funds.

The object of the National Engineering Laboratory is to establish the principles and extend the knowledge of mechanical engineering science so as to provide industry with the information it requires for the solution of its own particular problems. In order, therefore, that its work may be focused on practical objectives of real value to industry (which may involve basic or applied research or, in suitable cases, development work), the Council has decided that the planning of the laboratory's activities and the selection of research projects can best be under the control of a small body with a measure of executive authority. The new steering committee will be under the chairmanship of Vice-Admiral Sir Frank Mason, K.C.B., M.I.Mech.E., M.I.Mar.E., who is a member of the Research Council and chairman of the outgoing Mechanical Engineering Research Board. Admiral Mason, who was Engineer-in-Chief of the Fleet until his retirement from the Royal Navy in 1957, is now a director of Metal Industries, Ltd., and of H. W. Kearns and Co., Ltd. The other members of the committee will be: Professor O. A. Saunders, M.A., D.Sc., M.I.Mech.E., F.Inst.P., F.Inst.F., F.R.S., Professor of Mechanical Engineering at the Imperial College of Science and Technology; Mr. Norman Elce, M.Sc. Tech., M.I.Mech.E., director and chief mechanical engineer of Metropolitan-Vickers Electrical Company, Ltd.; Dr. D. G. Sopwith, M.I. Mech.E., director of the National Engineering Laboratory, and Dr. C. M. Cawley, F.R.I.C., director of Stations and Grants Divisions, D.S.I.R. This committee, which will be a full committee of the Research Council, is empowered to set up specialist sub-committees to provide technical advice on particular fields of work. In order to assist the director as the laboratory expands and to improve and extend the links between the laboratory and industry, two deputy directors have been appointed. They are Dr. S. P. Hutton and Mr. F. D. Penny. Dr. Hutton will have special responsibilities for fostering closer relationships with industry, Mr. Penny for the management of the research programme.

Detergents and River Pollution

THE second progress report of the Ministry of Housing and Local Government's standing technical committee on synthetic detergents has just been published.* Probably the topic in the report which will arouse greatest interest is the account of "a serious attempt" which has been made to produce an alternative material for use as a detergent, which would be more readily broken down by sewage works processes than detergents in current use. The report states that another type of alkyl benzene sulphonate, more readily decomposed than that in general use, has been prepared and investigated under laboratory and pilot plant conditions. Results so far show 87 to 94 per cent removal by biological filters or activated sludge aeration, as against 67 to 69 per cent correspondingly for present material. Thus it would give rise to less river pollution and cause little or no foam on rivers. Manufacturers consider the new detergent to be commercially feasible.

Foam continues to be a serious problem at a number of sewage works and on certain rivers and canals, the committee states. Opinion still appears to be divided on the relative merits of sewage effluent sprays and chemicals as foam suppressants at sewage works. The London County Council has been considering the possibility of intensive aeration of the influent to an activated sludge plant so that surface-active material can be removed in the form of foam and so kept out of the Thames. A large experimental plant is being considered to apply the methods on a works scale and see if they are economically possible.

The committee is satisfied that there has been no detectable change in the average concentration of synthetic detergents in sewage, effluent, and river water during the past two years. No new aspects of the problem have been reported, nor has there been any major change in the composition or volume of detergents retailed. However, synthetic detergent toilet bars are being test marketed in this country. The indications are that the surface-active agents incorporated in them are readily decomposed biologically and their use is not likely to affect the problem adversely.

Among the wide range of raw materials potentially available for making surface-active agents is sugar. Experimental work at Durham University indicates that the sugar-based materials tested there are readily broken down by bacteria, but it appears to the committee that considerable development work will be needed before it is known whether these materials can offer a satisfactory alternative to those materials at present used for making domestic detergents.

* H.M. Stationery Office, price 9d.

Driverless Guided Industrial Truck System

AT the last Mechanical Handling Exhibition, an equipment which attracted considerable interest was an electronic control system for powered trolleys and industrial trucks developed by E.M.I. Electronics, Ltd., of Hayes, Middlesex. This system, briefly described in our issue of May 16, 1958, made it possible to dispense with a driver when using trucks to deliver goods to specified points in a factory or warehouse. For it a wire is laid in the flooring along the proposed route and alternating current of a specified frequency passed through the wire. The trolley or truck has two sensing coils fixed on its front and these coils pick up signal currents from the magnetic field set up by the wire. The coils are connected to the vehicle steering control, and when the vehicle tends to wander from the path of the wire the current induced becomes unbalanced; amplified signals from the coils then operate a servo-motor coupled to the steering gear to return the vehicle to its path.

This "Rotobug" system, as it is known, is now being tried out at the Newton Abbot goods shed of the Western Region of British Railways. For this purpose two standard battery-operated trucks made by Scott Electric Vehicles, Ltd., have been equipped and they are being used to convey goods which have been discharged from rail wagons to chosen points for loading on to cartage vehicles. Nine wire tracks have been laid ½in below the floor surface and they are supplied with alternating current at about ½A of specified frequency. Overhead control panels are provided and the despatcher of a truck and its train of trolleys presses an appropriate button on a panel to set the path to be followed. The brakes of the truck are then automatically released and it sets off along the guide path to its destination. A safety bumper is fitted to the front of the electric truck and when it meets with an obstruction a micro-switch is operated to de-energise the interlock relay and halt the vehicle.

In selecting the truck to be used for the system, a Scott vehicle underwent a durability test in hauling a 3-ton load continuously for a distance of 2 to 3 miles at a speed of about 2 m.p.h. It was proved that the 121A hr. battery was sufficient to provide for an eight-hour working shift with the vehicle.

Driver-Guard Communication in Trains

IT is announced by the British Transport Commission that telephonic communication is to be provided between the guard's and driver's compartments of electric and diesel multiple-unit trains on British Railways. A telephone system between the guard and driver will be provided in all new electric and diesel multiple-unit trains, and will also be fitted in existing stock. The first of the existing trains to be equipped will be those which have at present no means of communication between guard and driver, to be followed by those already fitted with a bell or buzzer system. The telephone link will be maintained through the normal jumper connections between units, when two or more multiple-unit sets are coupled together, and will be fed from the train lighting batteries.

There are 2378 electric and diesel multiple-unit train sets in service on British Railways which are without telephonic communication between guard and driver, and 1867 of these units are to be fitted. The remaining 511 are older types which it would be uneconomic to equip. The 1867 units to be fitted include train sets of two, three, four, five and six cars, of which 672 are electric and 1195 are diesel-powered.

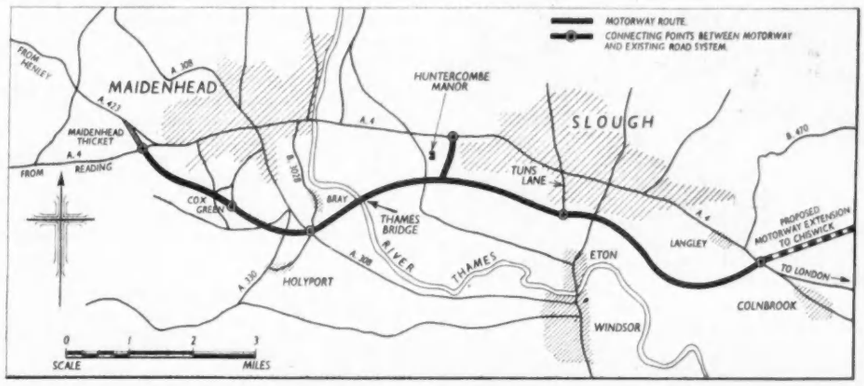
Award of the James Alfred Ewing Medal

SIR CLAUDE INGLIS was presented with the James Alfred Ewing Medal for 1958 at the Institution of Civil Engineers on Tuesday, April 21. This award is made on the joint nomination of the presidents of the Institution of Civil Engineers and the Royal Society for specially meritorious contributions to the science of engineering in the field of research, and is in this case in recognition of Sir Claude's research into river behaviour and loose boundary hydraulics. Sir Claude was appointed director of the then newly-established Hydraulics Research Station of the Department of Scientific and Industrial Research in 1947; he retired from the position last year. Most of his life has been spent in India. He was appointed director of the Indian Waterways Experiment Station at Poona in 1936, and brought the station from its infancy to a fully-fledged research station when he left in 1945. He was elected to Fellowship of the Royal Society in 1953.

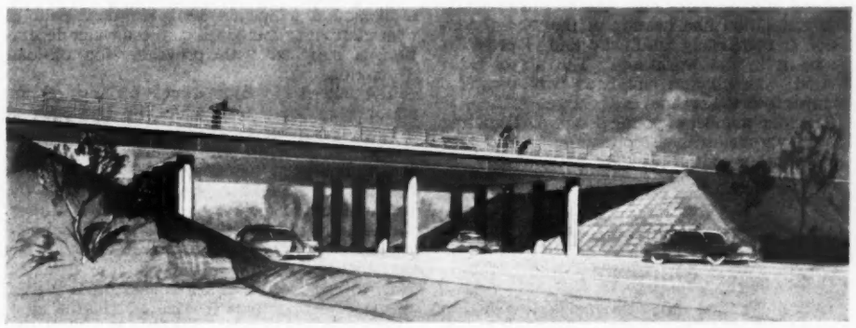
Maidenhead By-Pass Motorway

WORK is due to start next month on the construction of a motorway estimated to cost more than £2,500,000, to by-pass Maidenhead. Later it will be extended to by-pass Slough as shown on the accompanying map.

The first step will be the resumption of work on a bridge over the Thames at Bray, and on road works in Berkshire, both of which started before the war. The contract for the bridge has been awarded to Horseley Bridge and Thomas Piggott, Ltd., and for the Berkshire roadworks, John Laing and Son, Ltd. This first section of the motorway to by-pass Maidenhead, leaving the Bath Road, A.4, near Huntercombe Manor and rejoining it at Maidenhead Thicket, is expected to be finished by the end of 1960. Plans for its extension to by-pass Slough are being completed. The motorway will rejoin A.4 near Langley from where another section has been proposed as far as Chiswick, with a spur to London airport.



Motorway to by-pass Maidenhead and Slough ; the section now to be built is to the left of Huntercombe Manor



Artist's impression of the proposed Ascot road bridge on the Maidenhead By-pass motorway

The Maidenhead By-pass will be 6 miles long and will have twin two-lane carriageways. For a short section approaching and crossing the Thames, there will be separate tracks for cyclists and pedestrians but linked to the existing road system and not to the motorway.

Quite heavy earthworks are involved in the construction, there being an estimated quantity of about 100,000 cubic yards of excavation, and embankments with a total volume of about 200,000 cubic yards, necessitating considerable importing of filling. The carriageways will be built with an 8in thickness of dry lean concrete on a cement-stabilised gravel base. A 2½in asphaltic base course will be laid on the dry lean concrete, and topped by 1½in of hot rolled asphalt.

There will be fourteen bridges, including one to carry the motorway over the River Thames. This bridge will have a central span of 270ft and two 38ft side spans. It will have a steel superstructure, consisting of eight welded girders of mild and high tensile steel. The bridge deck will consist of a reinforced concrete slab cast *in situ* on top of the upper flanges of the main girders.

A large roundabout will be constructed at Maidenhead Thicket where the new road rejoins A.4. Here there will be a short link to the Henley Road, A.423, north of the junction. There will be two fly-over junctions to the south of Maidenhead, one near Cox Green and the other at the junction of the Windsor and Holyport Roads south of Bray. Where the by-pass turns north near Huntercombe Manor to rejoin A.4 there will be a two-level junction so that when the by-pass is extended beyond Slough the through traffic will not be impeded by traffic joining or leaving the motorway on this spur. There will be another large roundabout where the spur joins A.4.

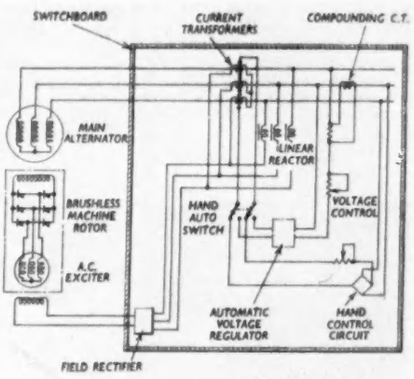
The works have been designed for the Ministry of Transport and Civil Aviation by the County Councils of Berkshire (county surveyor Mr. K. B. Brow, M.I.C.E.) and Buckinghamshire (county surveyor Mr. E. H. Frankland, M.I.C.E.). The Thames bridge consultants are Messrs. Freeman Fox and Partners ; the consultants for six of the bridges on the Berkshire section of the by-pass are by Messrs. Scott and Wilson, Kirkpatrick and Partners.

Brushless Marine Alternators

THERE are no sliprings or commutators in the brushless alternator made for marine service by the heavy plant division of Associated Electrical Industries, Ltd., Rugby and Manchester. Alternators of this design are available in ratings up to 1000kW and a typical machine is shown here in cross section.

As can be seen from this illustration, the alternator and exciter rotors are mounted on a common shaft, which also carries the silicon rectifiers whereby the a.c. output of the exciter is converted into direct current and is then fed directly to the alternator rotor (the field system).

The split frame of the exciter is overhung from the alternator stator and the axial length of the whole machine is short.



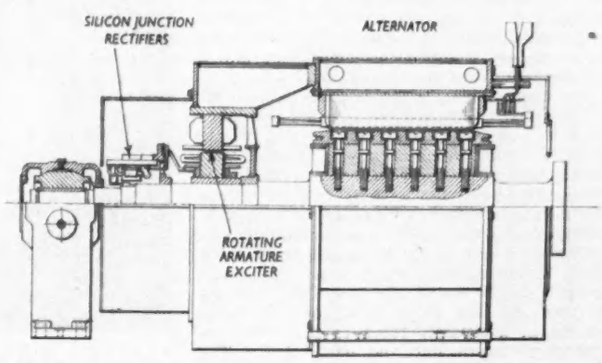
Schematic diagram of connections of brushless marine alternator

The silicon rectifier is a three-phase, full-wave equipment fed from the three-phase rotating armature exciter. The excitation of this exciter is derived from the main alternator output and is controlled by a " Magnestat " voltage regulator. Part of this excitation is provided by saturable current transformers and part by a three-phase linear reactor. Because the power required for excitation from the alternator is only a few hundred watts, the sizes of the saturable current transformers and the linear reactor can be made small enough to enable these equipments to be accommodated on the switchboard, as indicated in the schematic diagram of connections reproduced above. With its adequate residual magnetism the a.c. exciter provides reliable starting.

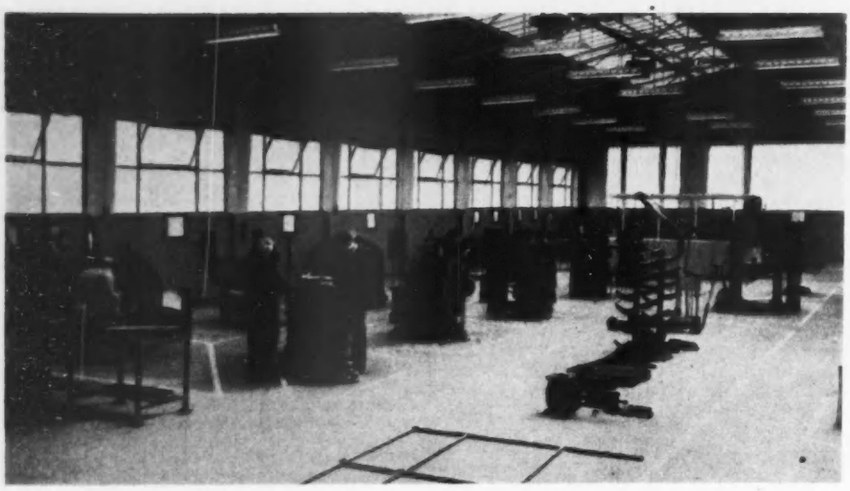
To ensure satisfactory sharing of wattless kilovolt-amperes when these alternators are run in parallel, the usual compounding characteristics are incorporated in the " Magnestat " voltage regulator. We learn that a steady-state voltage regulation of ±1 per cent can be obtained and the speed of response is high. A response time better than 0·5 second is specified for the standard brushless alternator without any kind of field forcing. Means are available for achieving faster response times, if required.

Vibrating-Cylinder Transducer

AN agreement has been concluded by the Solartron Electronic Group, Ltd., Thames Ditton, Surrey, with Svenska Flygmotor Aktiebolaget for manufacturing and marketing a new vibrating cylinder pressure transducer. The agreement covers all countries outside Scandinavia. The pressure-sensitive element of the transducer is a mechanical vibrating system with a natural frequency dependent on applied pressure. This element determines the frequency of a transistor feedback oscillator, thus providing an output voltage of constant amplitude but with a frequency which varies with the pressure applied. The oscillator is built on a printed circuit and encapsulated in epoxy resin. The variable-frequency signal is easily convertible to digital form for further treatment in a digital computer. Overall dimensions of the transducer are 1·5in diameter by 2·5in length and the weight is 2 oz. Production in this country has begun.



Cross section of 4-pole brushless marine alternator



Engineering workshop at the Bilston training centre

Steel Works Training Centre

In order to maintain an adequate supply of well-trained young men capable of dealing with the growing complexity of its plant and production processes, Stewarts and Lloyds, Ltd., established a training department in 1944. It operates under the control of a director of training and education, the several works and offices of the company being grouped in five training areas, namely, Bilston, Birmingham, Corby, Scotland and South Wales. In each area there is an area training officer with a full-time staff and the necessary facilities, including training centres, workshops and equipment. In general, provision is made for training junior works operatives, craft and technical apprentices, student apprentices, graduate apprentices and commercial apprentices. In addition, there are schemes for the training of adult operatives, foremen and superintendents and plant managers. But there is considerable freedom in each area to develop training as local circumstances dictate while conforming generally to the pattern that is common throughout the company.

The works at Bilston were taken over by Stewarts and Lloyds, Ltd., in 1925. In addition to the blast-furnace plant, there are six modern basic open hearth furnaces, casting pits and rolling mills, the products of the steel plant—mainly ingots, bars and billets—being sent to the company's works in other parts of the country for conversion into tubes. At present, the number of people employed at Bilston is about 2300. The training department there was started in 1945 when there was only one room available for its activities. Two years later, it was possible to extend the accommodation by the acquisition of three wooden huts and an asbestos-clad building; one of these buildings was equipped as a small engineering workshop and a laboratory. But in the training workshop, in particular, it was possible to accommodate only ten trainees at a time and each group had to be limited to only six months.

On Thursday of last week a new training centre at the Bilston works was officially opened by Mr. A. G. Stewart, chairman of Stewarts and Lloyds, Ltd. It was designed by the company's architectural staff and consists of a two-storey main building, a single-storey workshop and a two-storey building connecting them.

The main building accommodates the administrative offices, lecture rooms, library and laboratories, and some small cubicles for private study, a facility which is proving popular with the students. The upper floor of this building is divided into two main sections. On one side is the training laboratory fully equipped with fume cupboards, sinks, benches and appliances, and on the other side of the upper hall there is the main lecture hall in which more than sixty students can be seated at a time. The hall can be used for film shows, the projectors being housed in a separate room to show through cinema apertures into the hall below. The workshop at the back of the training centre is roofed with tubular steel trusses and is equipped with up-to-date machines for training. An interior view of the workshop is reproduced herewith. The two-storey connecting block contains the students' entrance, goods lift and showers and toilets for staff, visitors and students. The ventilation and heating of the whole main block is completely automatic and is provided by plant in the workshop. The air is twice filtered, warmed and circulated with complete changes four to six times every hour.

The total number of young people participating in the various schemes operating at the new centre is at present about 200.

200MW Turbo-Alternator for High Marnham

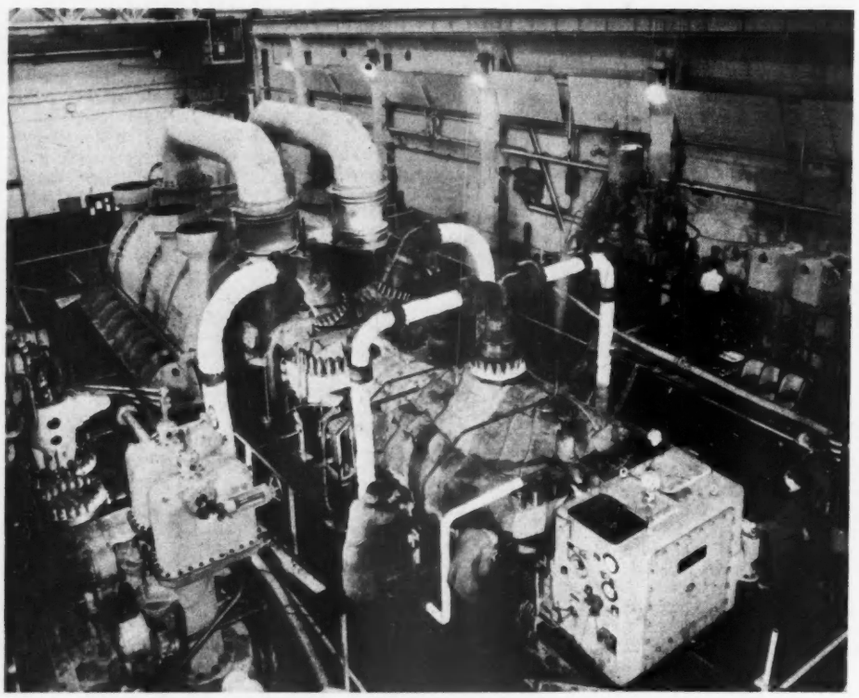
Our illustration shows the first of five English Electric 200MW, 3000 r.p.m. reheat steam turbines for the Central Electricity Generating Board undergoing works tests before installation in High Marnham power station. High Marnham lies on the West Bank of the River Trent close to the East Midlands coalfields and to the main railway line linking Chesterfield and Mansfield with Lincoln. The turbo-alternator sets will be arranged in line along the axis of the station at 120ft centres.

The technical development of these 200MW turbines was described in an article by John Caldwell in The Engineer, June 15, 1956. Briefly, the turbine is a horizontal three-cylinder machine having a double casing impulse type high-pressure cylinder. Steam enters the turbine stop valve at 2350 lb per square inch gauge, 1050 deg. Fah. The steam from the high-pressure turbine exhaust is reheated and then returned to the intermediate-pressure cylinder at 475 lb per square inch gauge and 1000 deg. Fah. The intermediate-pressure cylinder is combined with one section of the three-flow low-pressure cylinder and has impulse blading.

About one-third of the steam remaining after bleeding passes through the combined low-pressure portion, and the remaining two-thirds is led through two overhead interconnecting pipes to the low-pressure cylinder. The three-flow low-pressure cylinder exhausts to a single-shell condenser, the vacuum at the most economical and continuous maximum rating being 28·7in Hg. (bar 30in) when using cooling water at 60 deg. Fah. The condensing plant includes a single-shell condenser, two full-duty extraction pumps, three 50 per cent duty rotary Leblanc type main air pumps and two quick-starting exhausters.

There is a six-stage feed water system giving a maximum temperature of 460 deg. Fah. at continuous maximum rating. Feed water deaeration is supplied with provision for off-load deaeration.

The alternator uses direct cooling of the stator and rotor conductors by hydrogen at a rated gas pressure of 30 lb per square inch gauge. The hydrogen coolers are arranged longitudinally in the upper part of the stator frame and the gas is circulated through the machine and coolers by an axial flow blower. Generation is at 16·5kV with rated phase current of 7780A at 0·9 power factor. The exciters consist of a main and pilot unit arranged back-to-back on the same shaft and driven through gearing from the tail end of the alternator. They are totally enclosed and ventilated on the closed circuit principle, the air being circulated through the machines and coolers by means of a direct coupled fan. The maximum output of the main exciter is 3000A at a rated voltage of 520V, the speed of the exciters being 750 r.p.m.



The first of five 200MW repeat steam turbines for the C.E.G.B. station at High Marnham is shown on test at the Rugby works of The English Electric Company, Ltd.

Industrial and Labour Notes

Productivity

A meeting organised by the British Productivity Council, and held in London on Thursday evening of last week, was addressed by the Prime Minister, Mr. Harold Macmillan, and by the leader of the Opposition, Mr. Hugh Gaitskell. The Prime Minister, in emphasising that an increase in the technical efficiency of production was still the key to a higher standard of living, said that the scene was now set for the growth of productivity in 1959–60. In recent years, he remarked, there had been a considerable increase in investment in industrial capacity, but that had yet to be translated fully into growth in output. He hoped and believed that the Budget proposals would help to produce extra demand to match the extra capacity ; at the same time, investment allowances should help to maintain the pace of modernisation itself. But, the Prime Minister urged, this country should not count on a continuation of cheaper import prices. For stability in prices it would need to look to its own devices and particularly to the contribution that could come from a greater steadiness in home costs. The path to greater efficiency, he added, was through the free and enlightened co-operation of management supervisors and trade unions at all levels in industry.

Mr. Gaitskell began his speech by remarking that all-party support for higher productivity was no new thing. A high level of investment in new plant and machinery, he said, turned partly on government policies, but it also called for co-operation in industry. Changes, Mr. Gaitskell continued, were not always easy and reluctance and resistance to them had to be overcome not by force, but by persuasion ; the whole process would be impossible without trade union help and co-operation.

Shipbuilding Statistics

The Shipbuilding Conference has issued a statement concerning the first quarter of 1959, and this records that 53 ships of 55,000 tons gross were ordered during this period. These orders raise the total of new contracts, booked in the twelve months to March 31, to 158 ships of 511,000 tons gross, which compares with the 207 ships of 1,120,000 tons gross ordered during a similar period ended March, 1958. Thus, at the end of March the industry's order book included 592 ships of 5,103,000 tons gross, with an estimated value of £750 million, and of this total 17·5 per cent represents orders for foreign owners. Cancellation of orders during the quarter amounted to 62,000 tons gross, making the total cancellation for the twelve months ended March 330,000 tons gross.

Iron and Steel

Although steel production in March, at 362,700 tons a week, was higher than in February, it still fell below the figure achieved a year earlier. Pig iron output in March, at 221,000 tons a week, was much the same as in February. The Iron and Steel Board, in giving these figures, states that steel production in the first quarter of this year was about 4 per cent higher than in the last quarter of 1958. In contrast, pig iron output declined somewhat during the first quarter, mainly because of the smaller usage in relation to scrap at the steel furnaces.

The Iron and Steel Board has also stated that there was an increase in the deliveries of finished steel in the first quarter of this year, concurrently with the improvement in production. Deliveries of steel in February were at a higher rate than in January, and subsequent figures suggest that this higher level of delivery was maintained during March. The improvement in home deliveries applied to most users, but was particularly noticeable in the general engineering and motor-car manufacturing industries.

Manufacturing Industry's Stocks

The Board of Trade says that the total value of manufacturing industry's stocks and work in progress is estimated to have fallen during the final quarter of 1958 by about £44,000,000, or 1 per cent of the total value of stocks held. This decrease, which was slightly larger than that during the preceding quarter, was the third in successive quarters.

The value of stocks of materials and fuel, which showed no change during the third quarter of last year following decreases during the two preceding quarters, fell in the final quarter by about 1½ per cent. The value of work in progress also fell (by about 1 per cent) following increases during the first three quarters of last year. Stocks of finished goods, however, which had fallen during the third quarter after substantial increases during the first two quarters of last year, showed a slight increase in the final quarter. During 1958 as a whole, the total value of manufacturing industry's stocks and work in progress fell by £53,000,000 (1 per cent), compared with an increase of £257 million (6 per cent) during 1957.

Coal

Last week there was a meeting of the National Coal Board and the economic subcommittee of the National Union of Mineworkers to discuss the union's recent request that, in view of the existing coal surplus, there should be a further substantial cut in opencast production. A joint statement issued after the meeting said that the general economic situation of the coal industry was fully considered and the National Coal Board explained that it could not contemplate further cuts in opencast production which would involve breaches of contract. It was emphasised tnat the total opencast output for this year would not exceed the planned figure of 11,000,000 tons, or 3,000,000 tons less than in 1958. The union's representatives indicated that a further meeting with the Board on the general situation of the coal industry would be necessary ; tney said also that they proposed to raise with the Government the matter of reducing opencast production.

Last Monday, the Paymaster-General was asked in the House of Commons whetner the proposals for a national fuel policy, submitted by the National Union of Mineworkers, had been considered. He was asked also about the request for a greater reduction in opencast output. The Paymaster-General, Mr. Maudling, said in answer to these questions that the Minister of Power had made a full reply to the union's submissions. In the reply, the Minister had pointed out that, because of the need for an abundant, cheap and efficient supply of fuel for British industry, he could not accept the proposition that oil should be taxed or otherwise restricted in order to compel a greater use of coal. The Minister also emphasised that the substantial cuts in opencast production already announced for 1959 went as far as possible without breaking contracts.

The latest statistical return from the Ministry of Power shows that, in the first fifteen weeks of this year, ended last Saturday, total coal production amounted to 63,611,000 tons, compared with 65,658,500 tons in the corresponding period of last year. In the week ended April 11, distributed coal stocks amounted to 13,509,000 tons and undistributed stocks totalled 21,463,000 tons. A year earlier those figures were 14,452,000 tons and 8,485,000 tons respectively.

Agricultural Machinery

At the annual general meeting of the Agricultural Engineers Association, which was held in London on Thursday of last week, Mr. L. C. Pearch, chairman and managing director of Kent Engineering and Foundry, Ltd., was elected president. He succeeds Mr. Lionel Harper, managing director of Massey-Ferguson (Sales), Ltd., who has served for three years.

Speaking at a luncheon after the meeting, Mr. Pearch said that last year the British agricultural machinery industry achieved the greatest sales figures of its history. Germany purchased British tractors worth more than £2,000,000, and, during the year, the U.S.A. became this country's largest foreign customer, second only to Australia. Further sales increases were achieved in the home market, Mr. Pearch added, tractor sales rising by 9 per cent, the sale of combine-harvesters by 3 per cent, and implement sales by 27 per cent over the 1957 figures.

Safety Code for Radioactive Device

Safety precautions for workers who may be exposed to ionising radiations arising from the inclusion of radioactive markers in " Go-devil " devices for the detection of obstructions in pipelines are set out in a new booklet entitled *Radioactive Markers in Go-devils : Safety Precautions*, which has been published by the Ministry of Labour. " Go-devils " consist of tightly fitted rubber washers, scraper vanes or wire brushes mounted on a central core. They are frequently used by oil, gas, water and other industries for detecting whether newly laid mains are free from obstruction, and in the routine maintenance of existing pipelines. " Go-devils " are pushed through pipelines by means of water or compressed air, and tney occasionally get jammed against an obstruction ; location of the cause can be an expensive procedure, involving excavations over a considerable length of pipeline. The inclusion of a radioactive marker in the central core, which is exposed on contact with an obstruction, will overcome the difficulty because the gamma rays given off by the radioactive material can be readily traced above ground. But the use of radioactive substances in these devices requires the observance of strict precautions to avoid hazards which arise, and a Code of Practice for persons engaged in such operations is set out in this publication. This new illustrated booklet is one of a series dealing with safety, health and welfare in industry being prepared by the Ministry of Labour and designed to give guidance and information about the best practices to be followed. The booklet is obtainable from H.M. Stationery Office, price 1s.

Soviet Chemical Congress

THE eighth Mendeleyev Congress was held in Moscow during the period March 16–23. Meetings of the twenty-seven sections and sub-sections heard more than 1500 reports, including fifty papers presented by foreign chemists from nineteen countries. The congress, which coincided with the 125th anniversary of Mendeleyev's birth and the ninetieth anniversary of his discovery of the periodic law of the chemical elements, was attended on certain days by between 10,000 and 11,000 people.

Important papers were presented dealing with the development of the Soviet Union's chemical engineering sector, including the trends towards large plants combining a number of different processes and automation, particularly in the field of polymers (V. Nikolayev). The discovery of properties akin to anti-ferromagnetism (ferrites) in live albumen, due to a concentration of up to 10^{18} per gramme of unpaired electrons, which was as high as that of metals (L. Blumenfeld), was stated to account for some of the phenomena of living matter such as the rapid transfer of energy along chains of albumen molecules. Complex fermentation processes and transfer of energy, it was said, take place not through consecutive collisions of albumen molecules, ferments, &c., but through intensive electronic exchange.

A new theory of alloys was said to establish the possibility of creating a practically endless variety of alloys with predictable properties from nearly all known elements. Solid solutions of iron, nickel and titanium had been obtained which were already being used industrially. Other studies had led to a revision of ionic theories of conductivity in quartz crystalline silicates, and inorganic glasses.

Direct chemical utilisation of nuclear energy would replace, within ten to twenty years, the present transformation of nuclear energy into thermal power and from it into electricity (A. Alexandrov). In this way, electrical energy would become a mere by-product. At the Voronezh nuclear power station, now under construction, radioactive waste would be used for treating large quantities of motor tyres. By passing gases through the reactor core it was possible to produce oxides of nitrogen, nitric acid, ammonia and nitrogenous fertilisers, as it were, "free of charge." Irradiation could be used to produce "grafted polymers" combining the properties of chemically incompatible starting products. The method was stated to offer unlimited opportunities for synthesising organic compounds, including the possibility of forming artificial "living" substances. A new theory of molecular linkage was reported on by Y. Syrkin.

An extensive paper on the fundamental problems and main trends of nuclear chemistry was given by A. Vinogradov. One of the main problems was that of the interaction between elementary particles and heavy elements, the solution of which would shed light on the origin of the elements. By bombarding hafnium in the 660 MeV proton synchrotron, it had been possible for the first time to obtain from that element light isotopes of a number of rare elements. Such isotopes had also been created by the splitting of uranium. The experiments proved the possibility of forming lighter elements out of heavy elements as the result of interaction even with particles of considerably lesser power than cosmic rays. Investigation of meteoric material was stated to have shown traces of the splitting of iron, calcium and other elements. In the field of radioactive chemistry, the speaker referred to the dry technique of uranium separation, high-temperature work, and the beginnings of a study of the structure of matter by means of isotope exchange.

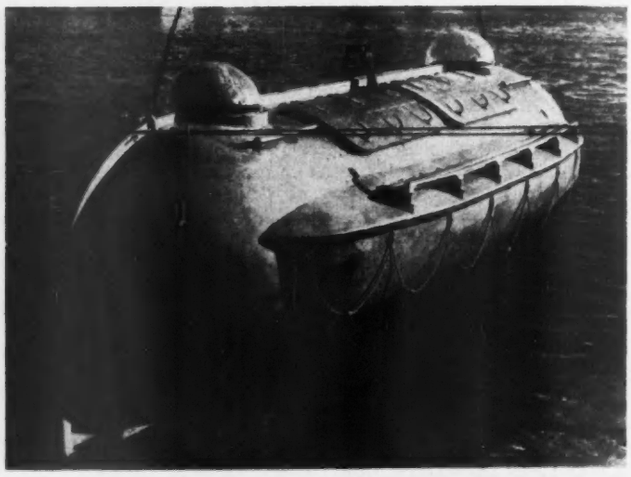
A theoretical possibility of extending Mendeleyev's Periodic Law to transuranic elements was referred to by V. Spitsyn. Work on the structure of nucleic acids and ribonuclease was discussed by V. Engelhardt. Soil cultivation was the subject of a lecture by A. Sokolov, who said that the output of mineral fertilisers in the Soviet Union would have trebled by 1965, reaching 35,000,000 tons. This, in turn, would yield an additional 32,000,000 to 49,000,000 tons of grain, over 3,200,000 tons of sugar, 2,000,000 tons of fibre, and 40,000,000 tons of potatoes. Moreover, this additional output would be obtained from old, densely populated and well-settled areas, whilst without fertiliser an additional area of virgin land of 150 million to 175 million acres would have to be cultivated. Regional agrochemical laboratories had been set up to study local conditions and requirements.

The next Mendeleyev Congress is to be held in 1962 or 1963.

Self-Righting Lifeboat

A plastic lifeboat which, it is claimed, will always return to an upright position, was recently demonstrated in Bremerhaven. With the idea of a submarine in mind, Ing. Gustav Kuhr of Lunewerft G. Kuhr designed the enclosed lifeboat, shown in our illustration. It has four hatchways for entering the boat and can be hermetically sealed so that no water can get into the boat even in rough seas. Bubble hatch windows fore and aft make it possible to keep a look-out even with hatches locked.

Because of the unorthodox shape of the boat the usual construction materials were considered unsuitable. Instead it was decided to make the hull of sandwich glass fibre reinforced polyester and hard P.V.C. foam, which gives the boat the exceptional strength required. The polyester resin was supplied by Reichhold Chemie AG, Hamburg.

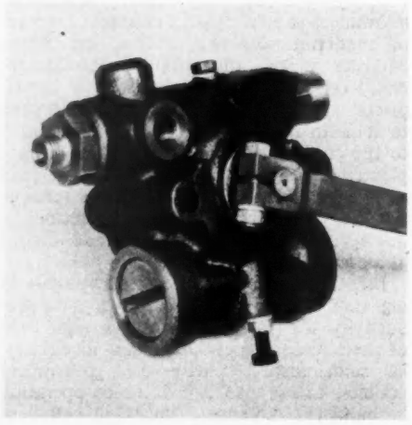


Completely enclosed self-righting lifeboat. The hull is a sandwich construction of glass-fibre reinforced polyester resin and hard P.V.C. foam

The overall length is 8m and the height 2·20m. The cabin is 6·25m long by 1·5m high by 2·90m wide, and has forty seats on four rows of benches, but these can hold more people than this. In addition the usual survival equipment is carried, including a sea anchor, diesel motor, and wireless set.

Level Adjustment Valve

In pneumatically sprung vehicles the air pressure in the suspension must be varied according to the load in order to maintain the distance between axle and chassis. The function of adjusting the pressure until the original level is restored is carried out by the special valve, shown in our illustration, which is made by Robert Bosch G.m.b.H., Stuttgart. This valve is fitted to the chassis and connected by means of a linkage to the axle. It comprises the valve portion proper and the damping cylinder. A single plate valve controls both inlet to and outlet from the pneumatic bellows which represents the spring element of the suspension. Such a design has been used by Bosch for a long time for compressed air brakes, where it is stated to have proved itself to be extremely reliable.



Valve for adjusting the pressure in a pneumatic suspension. By virtue of a damper cylinder the valve does not react to sudden suspension movements

Compressed air must enter or leave the bellows only if the loading changes, but not as the result of shocks from uneven road surfaces. In order to achieve this requirement a damping cylinder has been fitted. This is filled with liquid which can flow from one side of the piston to the other through a by-pass with an adjustable constriction. When the force on the damper changes slowly, as happens when the loading of the vehicle is altered, the liquid has time to flow through the orifice and the damper piston remains stationary, centred by a spring in its cylinder. As a result, the movement of the lever is transmitted through a ball drive to the valve and the amount of air in the main cylinder is adjusted. The ball drive is constructed in such a way that it disengages when the damper piston is displaced, as happens under the influence of sudden shock, when the damper liquid does not have time to pass through the orifice. In this case, therefore, the valve is not operated. Should, however, the vehicle load be altered suddenly to a new steady value, the valve, though not reacting immediately, will do so when the ball drive has been re-engaged under the action of the damper centring spring. The time for this is adjustable from 0·5 to twenty seconds, by varying the constriction in the damper by-pass.

Bordeaux Refinery

It is announced by Esso Standard S.A. Française, the French subsidiary of Standard Oil, New Jersey, which exploits the Parentis oilfield in South-west France, that its refinery near Bordeaux has come on stream. The installation has a throughput capacity of 1,600,000 tons per annum, and is equipped with a catalytic reforming plant with a daily capacity of 670 tons. It is connected with the Parentis field by a 12in pipeline 98km long.

Double Cantilever Bridge over the Carquinez Strait in California

BY OUR AMERICAN EDITOR

No. II—(*Concluded from page* 633, *April* 17)

With the opening to traffic on November 28, 1958, of a second highway bridge across the Carquinez Strait between Crockett and Vallejo, California, a critical road bottleneck was broken. The original bridge now carries three traffic lanes southbound towards San Francisco, and the new bridge carries four lanes northbound towards Sacramento. The main double cantilever bridge structure is 3350ft long and is supported on three caisson piers, one cofferdam pier and an anchorage pier. The design and construction of this bridge are of particular interest because of the extensive use of welded fabrication and high-strength steel bolting instead of riveting. Furthermore, the bridge superstructure constitutes the first application of the new "T-1" high yield strength structural steel of the United States Steel Corporation.

Bridge Superstructure

THE main part of the four-lane superstructure of the new Carquinez Bridge consists of double cantilever truss spans with a central tower. The two end anchor arms are each 500ft long and the two central spans are each 1100ft long. Including the 150ft central tower, the total length of the main structure is 3350ft. The two suspended spans are each 433ft 2⅜in long. The trusses are spaced 60ft from centre to centre and support a 52ft concrete roadway with two 1ft 10½in steel kerbs. The roadway slab for the two anchor arms is of standard-weight concrete while the slab for the remaining part of the structure is of light-weight concrete weighing 100 lb per cubic foot.

Three types of steel were used in the design of the superstructure. They are the American grades A7, A242 and "T-1," and their allowable unit tensile stresses are as follows : A7, 18,000 lb per square inch for all thicknesses ; A242, 27,000 lb per square inch for thicknesses of less than ¾in, and 24,000 lb per square inch for thicknesses of ¾in and 1½in; and "T-1," 45,000 lb per square inch for all thicknesses.

"T-1" is a high yield strength weldable constructional alloy steel developed recently by the United States Steel Corporation. In the design of cantilever trusses of this length, supporting four lanes of traffic with a concrete floor slab, one of the problems has always been the design of the heavily stressed members in the area of the supporting towers. These members frequently contain so many thick and heavy plates that their resistance to bending between joints produces high secondary stresses, sometimes greater than the primary stresses. In the past some of this difficulty with high secondary stresses has been overcome by the use of pin-connected eyebars and pin-connected compression members. The reliability of the pin-connected compression member to relieve secondary stresses is somewhat questionable, since the moment required to reproduce rotation in the pin may be as large as the moment induced by the secondary stress.

In any event, the use of a high-strength steel which would allow the make-up of members to retain reasonable flexibility appeared to be the best answer to the problem of secondary stresses. Two designs for these critical members are compared in the following table :

Comparative Design of Member L16–L18

	"T-1"	A 242
Maximum dead-load truss deflection ...	130 per cent	100 per cent
Moment of inertia ...	17,700in⁴	51,900in⁴
Bending stress	2900 lb per sq. in	19,200 lb per sq. in
Ratio of secondary stress to primary stress	10 per cent	110 per cent

One design utilises the conventional A.S.T.M. A242 steel and the other the new "T-1" steel. From these comparative figures it can be seen that the high-strength steel has a considerable advantage from the design standpoint and also yields a greater economy.

Fabrication Technique

Welded fabrication of girders and beams has become a fairly well accepted practice in many American states in the past ten years. California, for instance, has completed over 240 all-welded steel bridge structures and has many more under construction. This has involved the use of over 110,000 tons of all-welded steel girder construction, involving the use of the conventional A.S.T.M. A7, A373 and A242 constructional steels. The very satisfactory results of this rather large welded design experience led to the conviction that welded designs could also be extended to major truss fabrication with structurally satisfactory and economical results. Extending welded fabrication to the design and construction of major truss spans did appear to have several advantages over riveting which, of course, had to be weighed against the disadvantages before making this break with previous practice.

Favouring welded fabrication were the following factors : (1) experiences with past welded fabrication had been very satisfactory ; (2) it indicated considerable savings in the amount of metal used ; (3) it gave the designer greater leeway in the choice of member make-up and it simplified design details ; (4) fabricating shops were continually improving the quality and efficiency of their fabricating techniques ; (5) the testing laboratory of the California Division of Highways had done much to standardise testing and shop inspection procedures ; and (6) it made possible the use of the new high-strength steel "T-1" available in plates only.

Less favourable factors were : (1) this method of fabrication had not been used before in the United States on a large truss ; (2) there was no established engineering precedent for the member make-up or the standardisation of details as had been worked out for riveted fabrication ; and (3) some welded structures in the past had failed. Extending the use of welding to major truss fabrication was a strong break with established

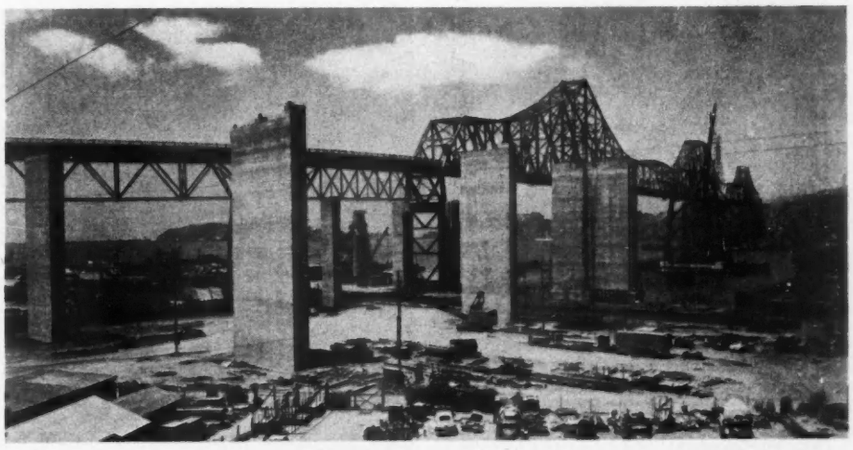


Fig. 9—Erection of bridge and approach piers

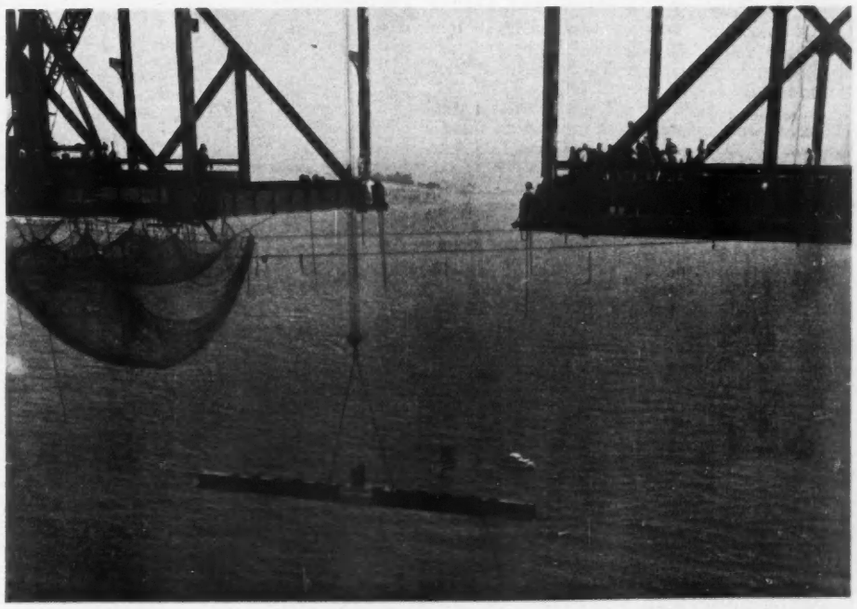


Fig. 10—Closing of cantilever truss superstructure in August, 1958

practice. But the outstanding advancements made in the past ten years in the knowledge and techniques of welding made this step now appear timely. As to member make-up, this point was discussed with leading fabricators and practical details were worked out, to the satisfaction of the designer and fabricator. Regarding the failure of a few welded structures, it was found that welding engineers and metallurgists had made such exhaustive studies following the failure of ships, that they now had a much better understanding of how to avoid such difficulties.

Early preliminary designs using conventional A7, A373 and A242 steels and limiting plate thickness to 2½in indicated that the required depth for the heavily stressed members would be 40in. This depth of member produced rather high secondary stresses, and the area of steel in each section produced members awkward to design and fabricate and members heavy to handle and erect. A steel with a higher allowable working stress was therefore considered because it would facilitate a reduction in member depth and, at the same time, keep the plate thicknesses for most members to 2½in without the use of multiple side plates, resulting in a considerable reduction in weight. The new quenched-and-tempered " T-1 " steel was therefore considered. With the minimum yield strength of " T-1 " steel at 90,000 lb per square inch, a conservative working stress of 45,000 lb per square inch in tension and comparable working stresses in compression were used in trial designs. The resulting trial member make-up for the heavily stressed members indicated that they could be kept to a 36in depth which resulted in a major reduction in secondary stresses. In addition, there was a large reduction in the tonnage of steel required, which amounted to 4,255,000 lb and, in addition, the weight of the individual members for erection was nearly halved.

As an example, the savings in weight per foot for member L16–L18 was reduced from 840 lb to 470 lb per foot when changed from riveted A.S.T.M. A94 steel to welded " T–1 " steel. It was therefore decided that " T–1 " steel had sufficient potential qualities to make worth while a thorough investigation of its use for welded truss members. Accordingly, the state testing laboratory conducted extensive tests on the welding and physical qualities of the steel, using 3000 lb of steel plates furnished by the U.S. Steel Corporation. From these plates, numerous specimens of butt-welded joints were made in thicknesses of ½in, 1in and 1½in. The welds were prepared using semi-automatic shielded arc, automatic submerged arc, and three kinds of manual low-hydrogen processes. The conclusion deduced from these tests was that " T–1 " steel could be satisfactorily welded into truss members but that narrow tolerances in the operating procedures were necessary.

The allowable working stresses used for A7, A373 and A242 steels were the same as those used in the Bridge Specifications of the American Association of State Highway Officials (A.A.S.H.O.). For " T–1 " steel members the allowable working stress used for tension members was 45,000 lb per square inch and that for compression members was $36{,}000 - 1{\cdot}75\,(L/r)^2$. The A.A.S.H.O. Bridge Committee is now considering the inclusion of such working stresses for " T–1 " steel in its bridge specifications.

The welded fabrication of the bridge members proved satisfactory for all steels, including " T–1." The members arrived on the job straight and true to dimension. The entering tolerances at the ends of members were accurately maintained, and this factor simplified and greatly sped up erection. The smooth surfaces of the welded fabrication had one drawback, however ; the lack of the usual rivet heads cramped the style of the steel erectors in climbing the members !

While the welded design and fabrication proved satisfactory in every respect, the job was not completed without some difficulties. During the latter part of April, 1958, the erection crews, due to a cable sling failure, dropped one of the heavy tension diagonals into Carquinez Strait. The member landed with the gusset plate end down, which penetrated the mud, sand and gravel for several feet. Upon recovery of the member, the gusset plates were found to be sufficiently bent to require replacement. It was decided that both the butt welds and fillet welds

Fig. 11—Finishing of concrete deck of cantilever truss span

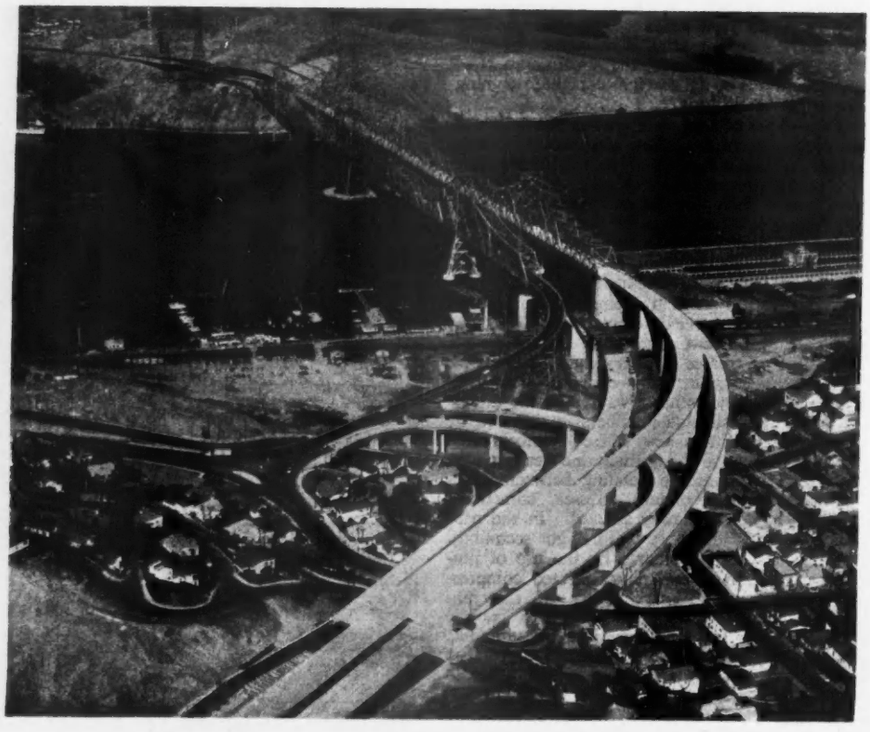


Fig. 12—Completed bridge structure with Crockett interchange in foreground

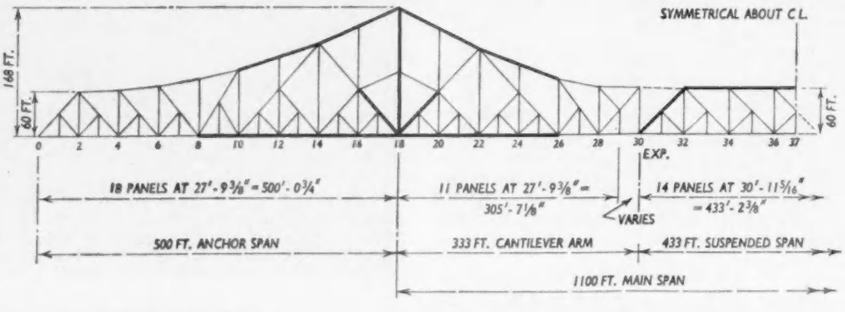

SYMMETRICAL ABOUT C.L.
168 FT.
60 FT.
60 FT.
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 37
EXP.
18 PANELS AT 27'-9⅜" = 500'-0¾"
11 PANELS AT 27'-9⅜" = 305'-7⅛"
14 PANELS AT 30'-11⅝" = 433'-2⅜"
VARIES
500 FT. ANCHOR SPAN
333 FT. CANTILEVER ARM
433 FT. SUSPENDED SPAN
1100 FT. MAIN SPAN

Fig. 13—Truss layout, showing members fabricated from "T—1 " steel by heavy lines

should be checked since the member had been subjected to severe impact and bending stresses. The butt welds were found to be in perfect condition but inspection of the fillet welds revealed an occasional very fine transverse crack in the fillet weld metal.

These fine cracks were at first thought to be very minor surface cracks or slag inclusions but further investigation revealed that some of them extended through the full section of weld. Furthermore, it was determined that the cracks had occurred before the shop coat of vinyl wash had been applied and were therefore not the result of shipping or handling. It was therefore concluded that something had occurred during at least some of the fillet welding process that was not in accordance with the narrow tolerances specified. The contractor immediately started checking the fillet welds of other members. As a final result of this check, a total of fifty-six

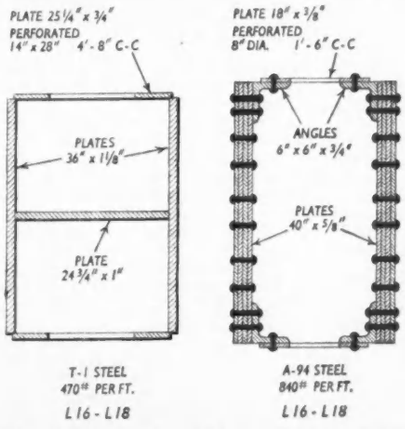


Fig. 14—Comparison between welded member L16–L18 on new bridge and riveted member L16–L18 on old bridge over Carquinez Strait

H-section tension members were repaired, some of which were fabricated from A242 and some from "T–1" steel. None of the compression box-section members were found with any fillet welds not up to specifications.

The repairs consisted of removing fillet welds flush to the plate surfaces with a slight trace of the fillet toe remaining to aid the welders in replacing the right size of fillet weld. In cases of any cracks that penetrated to a greater depth, it was necessary to gouge out to the full depth of the fusion zone to remove all crack traces. The fillets were removed with an "Arcair" gouging tool and were made in intermittent lengths of 5ft in the interior portion of beam and about 1ft 6in near the beam ends. In all, there were fifty-six truss members that required repairs out of a total of more than 1100 truss members, representing about 3 per cent of the total fabrication tonnage. It appears that the two most likely sources of trouble were moisture or variations in the equipment operation beyond the close tolerances intended, such as the voltage or current surging.

The presence of moisture which results in hydrogen inclusion in the weld could come from three sources: the flux, the welding rod or free moisture in the joint at the time of welding. It has been concluded that the type and manufacture of the four steels used were completely satisfactory and that the welding specifications used were satisfactory with but minor changes. The state testing laboratory now has hopes of developing the Sperry ultrasonic "Reflectoscope" as a device for checking fillet welds for this type of very fine transverse crack. It is confident that on future jobs of this type, any such difficulty will be detected immediately after the welding procedure, to enable the necessary corrections to be made on the spot.

High Strength Steel Bolts

All bracing and truss joints were fastened by the use of high strength steel bolts. The bracing bolts were ⅞in and the truss joint bolts were 1in and 1¼in. The bolts were supplied and installed in accordance with the "Specifications for Assembly of Structural Joints Using High Strength Steel Bolts," approved February 27, 1954, by the Research Council of Riveted and Bolted Structural Joints of the U.S. Engineering Foundation. The specifications called for field joints to be bolted but gave the contractor the option of using either rivets or bolts for shop joints. The American Bridge Division of the United States Steel Corporation chose to use shop bolted joints because of the heavy gusset plates and heavy members which required a considerable force to draw up to a tight fit. The use of high strength bolts has proved completely satisfactory on this job and was one of the big factors contributing to the very fast rate of erection attained. On most heavy truss work of this size, it is frequently necessary to bolt up a joint completely prior to riveting, in order to have the joint drawn up tight ahead of any riveting. As a result, it is estimated that one bolting crew of two men can more than equal the work of a four-man riveting crew. For this reason, the bolting crews were easily able to keep pace with erection which, it is believed, would not have been possible with riveted joints.

The bolts were tightened by "Chicago Pneumatic" impact wrenches. These impact wrenches were actually designed for ⅞in diameter bolts but were used for the 1in and 1¼in bolts as well. On the joints with 1in bolts, it was necessary for the bolting crews to go over each joint twice with the impact wrench opened to maximum capacity before each bolt was sufficiently tight. On the few joints with 1¼in bolts it was necessary to go over the joint as many as three times to ensure tightness. Testing was done by inspectors using a "Snap-on-Tools" torque wrench. Only about every third bolt was tested unless several bolts in a joint were found below minimum torque requirements, and then all the bolts in that joint would be tested. The bolts were not checked to see if they exceeded any maximum torque because the nut will nearly always strip before the bolt reaches an unsafe tensile stress. Both the impact wrenches and torque wrenches were occasionally checked by the Skidmore-Wilhelm Bolt Tension Test Device which is designed for the calibration of impact wrenches.

Toll Plaza

The toll plaza is situated about 1000ft from the north end of the main bridge on the Solano County side. It consists of an administration building and sixteen one-side toll booths of the modern barrier form, with provision for four additional booths should future traffic require them. Each toll booth is equipped with automatic axle counters and photo-electric vehicle counters. There is a nominal fee of 25 cents for passenger cars, and trucks are charged by the axle rather than by weight.

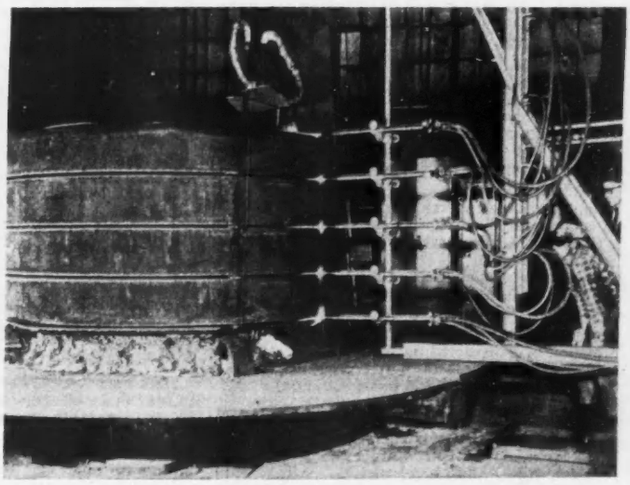
The work in connection with this 46,000,000 dollars Carquinez Toll Bridge Project was administered by the California State Division of Highways under the direction of G. T. McCoy, State Highway Engineer, and with L. C. Hollister acting as Project Engineer.

Turntable Rig for Flame-Cutting

An unusual flame-cutting procedure has made it possible for the Midvale Heppenstall Company, of Philadelphia, Pennsylvania, to reduce production costs. In standard flame-cutting operations, cutting torches are moved over a stationary workpiece. But in the new set-up at Midvale Heppenstall, the work is positioned on a controlled speed turntable and is rotated past stationary cutting torches. On the rig illustrated, large multiple ring forgings were flame-cut into equal-sized rings in less than one-tenth the time normally required for machining. In the operation shown, five Linde "Oxweld" torches mounted on a vertical rig slice the big forgings horizontally as they rotate past the torches. One man regulates the speed of the turntable and controls the intensity of the cutting flames. The machining time is drastically reduced, and one job on forged rings, which formerly took 320 hours, is now machined in less than 115 hours using the new method.

Any kind of steel from low carbon to high alloy can be cut with this set-up which handles work from 36in o.d. to more than 200in o.d. The turntable speed can be accurately controlled from 0 to 20 turns per hour. Parts weighing up to 120,000 lb can be carried on the turntable. The torch carriers move on tracks that are radial to the table. The torches mounted on the horizontal arm are also used to make bevels and vertical cuts. Vertical cuts and deep 40 deg. chamfer-cuts on the inside of the rings are made simultaneously, with less than 1in being left on the cut faces for machining.

Fig. 15—Northern bridge approach, with toll plaza and administration building



Cutting of multiple ring forging into four pieces by turntable rig

Personal and Business

Appointments

MR. A. H. HIRD, M.I.Mech.E., has been appointed a director of English Steel Corporation, Ltd.

MR. R. C. STEVENS has been appointed assistant sales manager of Clarkson (Engineers), Ltd.

MR. S. SLINGSBY, M.I.E.E., has been appointed production manager of Johnson and Phillips, Ltd.

MR. L. ROTHERHAM has been co-opted to the Council of the British Welding Research Association.

MR. W. J. DRAKE has joined Rijon Engineering Company, Ltd., and Swindon Tool Company, Ltd., in the capacity of sales manager to both firms.

MR. C. ROBERTSON KING, deputy chairman of the Central Electricity Generating Board, has been elected president of the Electrical Industries Club.

MR. E. A. SKINNER has been appointed general manager of Alfred Ellison, Ltd., in succession to Mr. H. Hanks, who has been appointed a director.

MR. G. W. GROSSMITH has been appointed chairman, and Lt.-Col. Eric Ward, A.M.I.Mech.E., managing director, of Strachan and Henshaw, Ltd.

MR. A. G. GILBERTSON has been appointed managing director of the Brown, Lenox group of companies, and chairman of Brown, Lenox and Co. (London), Ltd.

LORD STRATHCLYDE has been appointed chairman of the North of Scotland Hydro-Electric Board from July 1, 1959, to June 30, 1962, in succession to the Rt. Hon. Thomas Johnston.

SHORT AND MASON, Ltd., has announced that Mr. William K. Gregson has joined the company as northern area representative and will operate from 32, Park Road, Sale, Cheshire.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., announces that Mr. H. Walker has been appointed assistant manager—staff recruitment and training, in the personnel department.

MR. H. J. TYLER, purchasing officer of the London division of the Central Electricity Generating Board, has been appointed regional purchasing and contracts officer for the Eastern, London and South Eastern Region.

MR. RALPH CHILES has been appointed chairman of the Longclose Engineering Company, Ltd., in succession to Mr. E. Warwick Broadbent, who has retired from the board after forty-three years' association.

THE MINISTRY OF HOUSING AND LOCAL GOVERNMENT announces that Mr. H. R. Savage has been appointed principal private secretary to the Minister, Mr. Henry Brooke, in succession to Mr. R. O. C. Winkler, who has been promoted.

THE BRITISH BROADCASTING CORPORATION has announced the appointment of Mr. S. W. Amos, A.M.I.E.E., as editor, technical instructions, engineering training department, in succession to Mr. J. W. Godfrey, who is retiring from the post.

CHARLES CHURCHILL AND CO., Ltd., has announced that Mr. George S. Cutts has been appointed sales manager, combining the sales of machine tools and of engineers' supplies. Mr. W. Berridge has been appointed group projects engineer.

ATLAS COPCO (GREAT BRITAIN), Ltd., announces the retirement of Mr. Walter Wehtje as a member of the board. Mr. Marcus Wallenberg has been appointed to succeed him as chairman of the company. Mr. Nils Vult von Steyern has been appointed deputy chairman, and Mr. Marc Wallenberg, Jr., a director.

RALEIGH INDUSTRIES, Ltd., announces that Mr. D. P. Harris, A.M.I.Mech.E., has been appointed technical director of the Raleigh organisation and a director of Sturmey-Archer Gears, Ltd. Mr. Leonard Shakesby has been appointed chief production engineer and has also been appointed to the board of Rudge-Whitworth, Ltd.

THE CENTRAL ELECTRICITY GENERATING BOARD has announced the following appointments: Mr. E. C. Scott, M.I.E.E., system operation engineer at the Board's headquarters; Mr. P. K. Davis, M.I.E.E., divisional electrical engineer of the Eastern Division, and Mr. C. L. Jaques, M.I.Mar.E., chief generation engineer of the Eastern Division.

BRUCE PEEBLES AND CO., Ltd., has approved the formation of a divisional board of management and the following appointments have been made thereto: Mr. William M. McKenzie (administration); Mr. R. W. Flux, M.I.E.E. (transformers); Mr. D. McDonald, A.M.I.E.E. (engineering); Mr. J. H. P. de Villiers, M.I.E.E. (rotating plant); Mr. N. L. Jones, Associate I.E.E. (sales); Mr. J. W. Haig-Ferguson, A.M.I.Mech.E. (electronics). Mr. William M. McKenzie will retain the secretaryship. Mr. D. McDonald has been appointed chief engineer of the company. Bruce Peebles and Co., Ltd., has also announced the appointment of Mr. C. Phillips, A.M.I.Mech.E., as general works manager, and of Mr. G. Anderson as assistant general works manager.

MR. G. COLIN HEPWORTH has been elected to the board and appointed managing director, engine components division of Associated Engineering, Ltd., and has relinquished his seat on the board of Hepworth and Grandage, Ltd., and its subsidiaries. Mr. Jack L. Hepworth, previously joint managing director, has now taken over as chairman and sole managing director of Hepworth and Grandage, Ltd., and its subsidiaries.

Business Announcements

THE BRITISH CYCLE AND MOTOR CYCLE INDUSTRIES ASSOCIATION has moved to new headquarters in Eaton Road, Coventry.

MISS DOROTHY SMITH, M.I.E.E., has retired after forty-three years' service with Metropolitan-Vickers Electrical Company, Ltd.

MR. VERDON O. CUTTS, manager of the process heating department of The General Electric Company, Ltd., has retired.

MR. L. A. PUGHE, sales director of Sumo Pumps, Ltd., has left London by air to visit Kenya, the Rhodesias, South Africa, and the Sudan.

JOHNSON, MATTHEY AND CO., Ltd., has acquired an interest in the Italian precious metal refining and manufacturing company, Metalli Preziosi S.p.A., of Milan.

PRITCHETT AND GOLD AND E.P.S. COMPANY, Ltd., Dagenite Works, Dagenham Dock, Essex, has taken over the trading activities of the Alton Battery Company, Ltd.

RANSOME AND MARLES BEARING COMPANY, Ltd., has moved its London office from Victoria Street to Cranmer House, 39, Brixton Road, S.W.9 (telephone, Reliance 6771).

SIR WILLIAM HALCROW AND PARTNERS announce that Mr. V. A. M. Robertson, M.I.C.E., is to retire from the partnership on April 30. He will remain as a consultant to the firm.

NEWMAN INDUSTRIES, Ltd., Electric Motor Division, has opened an additional area office at 59, Grey Street, Newcastle upon Tyne, 1 (telephone, Newcastle 2-3970). Mr. R. Martindale is the new area manager.

THE ENGLISH ELECTRIC COMPANY, Ltd., has opened a sub-office at 14, Albert Road, Middlesbrough (telephone, Middlesbrough 44346/7). Mr. A. R. Johnson, A.M.I.Mech.E., A.M.I.E.E., is in charge.

THE GATE MACHINERY COMPANY, Ltd., 172/178, Victoria Road, London, W.3, commenced trading on January 1. The company handles second-hand machine tools, with special emphasis on heavier plant.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., has reduced the prices of "Fluon" polytetrafluorethylene by about 12 per cent. Since March, 1956, the granular form has been sold at about 40 per cent of the initial, 1948, price.

METAL CONTAINERS, Ltd., 17, Waterloo Place, Pall Mall, London, S.W.1, has appointed Turner and Brown, Ltd., Davenport Works, Davenport Street, Bolton, as sole northern agent for "Valethene" moulded polythene tanks up to 250 gallons capacity.

BRISTOW HELICOPTERS, Ltd., will offer a taxi service from the Westland Heliport, Battersea, from to-day. Westland "Widgeon" aircraft will be available, but initially the service will be confined to flying in daylight. Machines can be booked in advance.

NORTHERN ALUMINIUM COMPANY, Ltd., Bush House, Aldwych, London, W.C.2, has announced that it will shortly establish a new branch of its aluminium fabricating industry in New Zealand. The general manager of the new branch will be Mr. T. E. L. Ashley.

DR. J. N. ALDINGTON, managing director of Siemens Edison Swan, Ltd., and a director of Associated Electrical Industries, Ltd., has left the United Kingdom by air for India, where he will visit the Durgapur steel works. Dr. Aldington will also visit Australia and New Zealand.

THE YALE AND TOWNE MANUFACTURING COMPANY states that all communications concerned with advertising, sales promotion, printing and public relations for the British materials handling division and the British lock and hardware division should in future be addressed to the advertising and sales promotion manager, British Divisions, Willenhall, Staffs (telephone, Willenhall 145).

THE SHEFFIELD WIRE ROPE COMPANY, Ltd., Darnall, Sheffield, has been acquired by the Firth Cleveland Group of Companies. Mr. C. W. Hayward, chairman of Firth Cleveland Ltd., has been appointed chairman of the company. Other directors are Mr. E. S. Mead, Mr. R. S. H. Shepard, Mr. G. F. Chambers, Mr. S. K. Wheatley, Mr. H. V. W. Buckler and Mr. B. Allen.

SOUTH WESTERN ELECTRICITY BOARD has announced changes in the organisation of its Taunton district, which now includes the former Taunton, Bridgwater and Minehead districts, and those parts of the Exe Valley and Barnstaple districts which are in the County of Somerset. Branch managers of the board's new Taunton district are as follows: Minehead, Mr. G. Lovell; Bridgwater, Mr. L. G. Hooper; Glastonbury, Mr. E. R. Lunnon; Burnham-on-Sea, Mr. H. W. Jefferis; Dulverton, Mr. A. J. Luxton, and Langport, Mr. E. W. Garwood.

Contracts

CONSTRUCTORS JOHN BROWN, Ltd., has been awarded the contract for the construction of the Dow Agrochemicals plant at King's Lynn. This project, the cost of which is estimated at £1,000,000, is due for completion by mid-1960.

THE POWER-GAS CORPORATION (AUSTRALASIA) PTY., Ltd., Australian subsidiary of The Power-Gas Corporation, Ltd., Stockton-on-Tees, has received an order worth £A800,000 for one unit of carburetted water-gas plant from the Australian Gas Light Company for the Mortlake Works, Sydney. The unit will have a normal capacity of 9,000,000 cubic feet of 550 B.Th.U. gas per day, with a peak load capacity of 12,000,000 cubic feet per day.

PLENTY AND SON, Ltd., has recently received orders from overseas, as follows:—From Finland, for installation in the Neste Oy refinery, Helsinki, an oil-jacketed variable delivery bitumen pump, to be supplied complete with 100 h.p. flameproof motor and other equipment; from Emoleum N.Z., Ltd., New Zealand, five variable delivery pumps with motors and control gear for a bitumen blending and distribution plant at Auckland; from the Berre-Pauillac refinery, Bordeaux, a steam-jacketed variable delivery pump for cutback bitumen; from the Shell Company of South Africa, for installation near Capetown, for blending and bunkering, two 400-ton per hour servo-controlled variable and reversible pumps for heavy and light fuel oils; from B.P. Benzin and Petroleum A.G., Germany, for a refinery at Hamburg, two high-pressure heavy-fuel-oil variable delivery pumps, complete with gear drives and accessories.

PYE TELECOMMUNICATIONS, Ltd., has been awarded a contract by the Iranian Oil Operating Companies for providing a radio communications system between Kharg Island in the Persian Gulf, the oilfield at Gachsaran and the Agha Jari oilfield. A twelve-channel v.h.f. system will be installed, using frequency-modulated multiplex radio telephone equipment, and the link will traverse 160 miles of sea, coastal plains and mountain ranges. There will be five repeaters and three terminal stations, the intermediate terminal at Gachsaran being located at the telephone exchange serving the Gachsaran district. At Agha Jari the v.h.f. scheme will be linked with trunk lines to the principal Iranian centres and with the local network serving the Agha Jari oilfield. Apparatus will be in duplicate throughout, and a failure in any section will bring the stand-by equipment into action and send a warning signal to the central station at Gachsaran, indicating the section which requires servicing. In all, telephone traffic would be interrupted for rather less than five seconds while the changeover took place.

Miscellanea

FIFTIETH ANNIVERSARY.—To mark the fiftieth anniversary of the founding, on April 14, 1909, of Anglo-Persian Oil Company, as it was originally named, The British Petroleum Company, Ltd., has published a book entitled *B.P. Fifty Years in Pictures*. As the title suggests, the book traces pictorially the history of the company to the successful conclusion of the seven years of exploration, by W. K. D'Arcy, when oil was struck at Masjid-i-Sulaiman. The pictures show the early development difficulties and the first users of the oil and also the expansion in research, markets, transport and distribution which took place between the wars. Illustrations indicate the role played by oil in the second world war and the increasing European reliance on Middle East oil supplies, and the construction of new refineries in Europe, the Middle East, Canada and Australia. The search in many lands for new sources of crude oil is shown together with examples of modern sea and land transport and the wide fields covered by research.

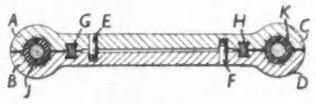
British Patent Specifications

When an Invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings, unless otherwise stated. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

OVERHEAD LINES

811,038. July 15, 1957.—SPACING DEVICES FOR OVERHEAD CABLES, Balfour, Beatty and Co., Ltd., 66, Queen Street, London, E.C.4, and André Rubber Company, Ltd., Hook Rise, Kingston By-pass, Surbiton, Surrey.

When two or more cables suspended between supports in an overhead electrical transmission system run closely together and it is necessary to ensure that they do not come into contact with each other, spacing devices are fixed between the cables at



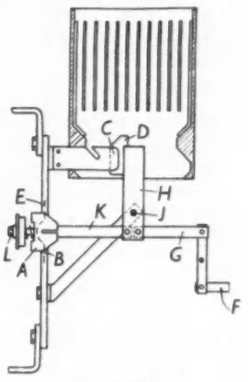
No. 811,038

intervals along their length. Deterioration of both the cables and the spacing device itself can be greatly reduced if each cable has a body or strip of rubber or other material having a rubber-like resiliency engaged around or partly around it and is held in a clamp by which the body or strip is compressed against the cable to maintain it firmly in position. According to the invention, the spacing device comprises a bar divided into two similar half cylindrical parts which fit together as shown in the drawing. Each part has an enlarged head *A*, *B* at one end and a similar head *C*, *D* at the other end. The two halves are located relatively to each other by spigots *E*, *F* and are held together by keys *G*, *H*. To fix the spacing device in position on a pair of cables, bodies of resilient material in the form of split bushes *J*, *K*, are placed around the cables. The lower half of the device is then placed in position with the bushes located in the grooves as shown. The upper half is then placed in position and locked by the keys. The bushes are initially of a slightly greater external diameter than the bores formed by the grooves. Thus when the two halves of the device are assembled together, the bushes are slightly compressed by the enlarged heads, which form two pairs of jaws, and are firmly anchored in position. The bushes are provided with end flanges to locate them in their axial direction in the bores formed by the grooves. They may alternatively be made with an external diameter equal to that of the bores but with an internal diameter less than that of the cables to be held within them. When the bushes are placed around the cables they are expanded and are then compressed again by the heads. As a further alternative the external diameter of the bushes may be made larger than the bores and also the internal diameter may be made less than that of the cables. The bushes are sufficiently thick to allow the cables to take up positions slightly skew to the centre lines of the bores formed by the grooves, thus allowing a small relative longitudinal movement between the cables to take place. For spacing apart three or more cables, the resilient bushes may be held in clamps disposed around a ring-shaped spacer member or, alternatively, the spacer member may have a number of arms equal to the number of cables and each arm has enlarged heads forming a clamp.—*March* 25, 1959.

ELECTRICAL ENGINEERING

810,925. December 21, 1956.—CIRCUIT BREAKER WITH MAGNETIC BLOW-OUT, Aktiengesellschaft Brown, Boveri et Cie, of Baden, Switzerland.

The invention consists in an electric circuit breaker with magnetic blow-out having main and at least one pair of sparking contacts actuated by an operating mechanism at the front of the circuit breaker. The main movable contact opens in the direction away from the operating mechanism, and is of such a shape that the dynamic forces of the currents tend to close the contacts. The movable sparking contact or contacts opens in the direction towards the front. The main contact is at the rear of the switch. There are no further structural parts impeding access to it, so that it can be removed and exchanged from the rear without any additional work. Referring to the drawing, the main contacts *A*, *B* comprise a bridge contact with two interruption points. In parallel with the main contacts are connected the sparking contacts *C*, *D*. The current flowing through the main contact forms a loop which tends to close contact *A*. Moreover contact *A* is so formed that a current loop arises therein as indicated by chain line *E*. A loop formed by the circuit breaker parts works in such a way as to seek to press the contact *A* on to the fixed contacts *B*. The current loop also has a tendency to close the contact. Actuation of the contacts is caused by an operating rod *F*. Upon opening the switch, lever *F* goes to the right and lever *G* to the left. It turns lever *H* round the pivot *J* and thereby opens the sparking contacts *C*, *D*. At

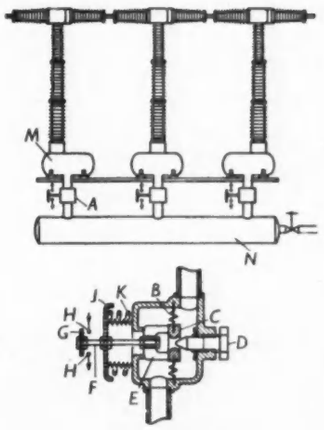


No. 810,925

the same time it presses the lever *K* to the left and thereby opens the contacts *A*, *B*. Contact *A* is accessible from the rear and can be removed by loosening bolt *L*. The entire arrangement is such that the length of the contact travel of the sparking contact is greater than that of the main contact due to the transmission ratio of lever *H*.—*March* 25, 1959.

810,763. September 6, 1957.—AIR BLAST CIRCUIT BREAKERS, Allmanna Svenska Elektriska Aktiebolaget, Vasteras, Sweden.

This invention relates to an air blast electric circuit breaker having a number of series-connected breaking gaps arranged in containers carried by pillar insulators, the containers and pillar insulators being filled with compressed air, which keeps the breaking gaps open. Protection is given against the air pressure disappearing in all breaking units, and the breaking gaps closing, when, for instance, one of the insulating pillars bursts. A valve *A* (see upper diagram) is

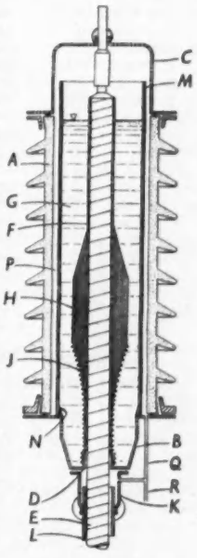


No. 810,763

arranged in the connection between each of the pillar insulators and a common compressed air source. The valve (see lower diagram) contains a diaphragm *B* which carries a nozzle *C*. The nozzle *C* may be moved to the right whereby the opening of the nozzle is closed by a member *D* adjustably fitted in the valve casing. The nozzle is connected to a spider *E* limiting the movement of the nozzle to the left. A rod *F* attached to the spider carries a contact bridge *G*, which can close a breaking gap between two contacts *H*. *J* is a disc adjustably fitted to the rod. Between the disc and the casing a spring *K* is arranged, which spring urges the nozzle to the left, and also a bellows *L*, which is attached in a gas-tight manner to the casing and the disc. Let it be assumed that the circuit breaker is open. The breaking gaps of the breaking units are then held in open position by the air pressure. If one pillar insulator bursts, the air pressure in the insulator and in the associated breaking unit decreases and the associated breaking gaps are closed. Air also streams out from the container *M* (top drawing) and from the common container *N* through the valve *A* to the container *M*. As the air pressure in the container *M* will be very low when an insulator has burst, the pressure drop in the nozzle will be high because of the throttling. The pressure difference between the two sides of the nozzle then causes a force which moves the nozzle *C* in the diaphragm *B*, so that the opening of the nozzle is closed by the member *D*, and an alarm circuit is closed at electrical contacts *H*. In an alternative form of valve shown in the specification the valve casing is formed as a cylinder inside which the nozzle moves, with a piston.—*March* 25, 1959.

810,365. September 17, 1957.—SEALING ENDS FOR GAS-PRESSURE ELECTRIC CABLES, Pirelli Societa Per Azioni, Viale Abruzzi 94, Milan, Italy.

The present invention relates to terminals for gas-pressure cables of the type in which the gas is in direct contact with the solid dielectric of the cable, and where the terminals contain an insulating compound. The terminal illustrated consists of a tubular porcelain insulator *A*, having a metal base *B* and a metal cap *C* containing gas under pressure and provided with a stuffing box *D* or its equivalent. The cable core *E* is wrapped in varnished silk *F* over the entire length for which it is immersed in the insulating compound *G*, for the purpose of preventing, in co-operation with the stuffing box, penetration of insulating compound into the cable. Over the binding there are then wound paper tubes *H* to form the insulating sleeve of the cable end, which sleeve is provided with electric screening *J*. Below the base of the terminal there is fixed the box *K*, which is filled with gas and into which there extends the metal tube or sheath *L* surrounding the cable core while leaving an interspace for the passage of the gas. This tube serves for connection to the trifurcation chamber fitted to the end of a three-core cable or, in the case of a single-core cable in which the gas is fed through an annular space provided within the sheath, it is the cable sheath itself. Inside the terminal, and coaxial therewith, there is a thin tubular jacket *M* made of insulating material which is fixed at *N* to the base of the terminal and is of an external diameter slightly less than the internal diameter of the insulator, so as to form a narrow cylindrical or conical interspace *P* permitting the passage of gas from the cable to the cap of the terminal. This interspace does not distort the electric field and, moreover, it is located in a zone which is little stressed electrically. In this way, the insulating jacket *M* also forms with the base a central chamber containing the fluid insulating compound. In this chamber, the level of the compound must not reach as far as the rim of the jacket, but must remain below it so as to prevent any part of the compound being able to flow into the interspace due to the effect of thermal expansion. The feeding of the gas into the interspace is effected by means of a small external metal tube *Q* which is fitted into the base of the terminal, so that the gas reaches the cap through the interspace and acts on the free surface of the insulating compound. The tube is normally connected to the box *K* filled with gas from the cable and may, as indicated, form a branch from the gas-supply tube *R*. The insulating jacket *M* has the sole purpose of creating a channel for the flow of the gas towards the upper part of the terminal and is not required to withstand the internal pressure.—*March* 11, 1959.

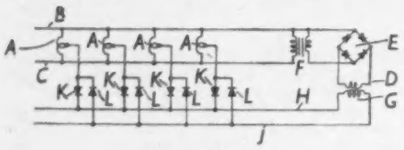


No. 810,365

810,093. December 12, 1955.—ELECTRICAL PROTECTIVE SYSTEMS, Ferguson Pailin, Ltd., 51, Buckley Street, Higher Openshaw, Manchester 11, Lancashire. (*Inventor: John Charles Palmer.*)

This invention has for its object to provide stability in a current-balance protective system even in the event of a broken connection from a current transformer winding. In the accompanying single-line diagram the secondary windings of a plurality of current transformers are indicated at *A*, these being associated with a plurality of feeders, for example connected with a section of busbars. The secondary windings are connected in parallel with one another by means of conductors *B* and *C* and with the operating coil *D* of a relay, the connection between the

parallel secondary windings and the operating coil of the relay being made by means of a full-wave dry-plate rectifier *E* and, if necessary, an auxiliary current transformer *F*. The relay is provided with a biasing or restraining coil *G* opposing the operating coil, the two ends of this restraining coil being connected respectively with bus connections *H* and *J*. The centre or other intermediate tapping of each current transformer secondary winding is connected with the two bus connections by means of respective half-wave dry-plate rectifiers *K* and *L*. In the operation



No. 810,093

of this arrangement, under normal conditions the voltages derived at the tapping points of the secondary windings are all equal to one another so that no voltage appears between the conductors *H* and *J* and the relay is unrestrained. Under through-fault or other certain transient conditions, however, the voltages at the centre-tappings are no longer equal to one another and spill current flows through the rectifier *K* connected to one or more of the centre-tappings, through restraining winding *G* and returns through rectifiers *L* associated with one or more of the other secondary windings. Spill current will similarly flow through the restraining winding *G*, thereby preventing operation of the relay, if one end of the winding *A* becomes disconnected, causing the voltage at the centre tapping of the winding to differ from that at each of the other windings *A*. In the event of a disconnection in or an earth fault on the busbar sections the voltages across windings *A* will become unbalanced producing a current for the energisation of relay coil *D*. The voltages at the centre tappings on the windings *A* however, remain the same so that the restraining winding *G* is un-energised thereby allowing the relay to operate to the current flowing in the current balance circuit.—*March* 11, 1959.

Launches and Trial Trips

HURRICANE, oil tanker; built by Barclay Curle and Co., Ltd., for Rafen and Loennechen, Norway; length 560ft, breadth 71ft 9in, depth moulded 40ft 6in, deadweight 19,700 tons; twenty-seven cargo oil tanks, two cargo pump rooms, one diesel and two steam-driven 125kW generators, two cylindrical multi-tubular auxiliary boilers; Wallsend-Doxford opposed piston oil engine, six cylinders 750mm diameter by 2500mm combined stroke, Bibby detuner. Trial, February 10.

WAVEBANK, cargo ship; built by William Doxford and Sons (Shipbuilders), Ltd., for the Bank Line, Ltd.; length between perpendiculars 450ft, breadth moulded 62ft, depth moulded 38ft 6in to upper deck, deadweight 12,160 tons on closed shelter deck draught; five holds, one 25-ton, four 10-ton and ten 5-ton derricks, Doxford opposed piston oil engine, four cylinders 700mm diameter by 2320mm combined stroke, 4800 b.h.p. Trial, February 20.

BAMBURGH CASTLE, ore carrier; built at the Neptune works of Swan, Hunter and Wigham Richardson, Ltd.; length between perpendiculars 485ft, breadth moulded 70ft, depth moulded 40ft 9in, deadweight 16,750 tons on 29ft 6in mean draught; two long ore holds on centre line, water ballast tanks in wing spaces; electric deck machinery; three 200kW diesel-driven generators; Swan, Hunter-Doxford four-cylinder opposed piston oil engine, 4200 b.h.p. at 110 r.p.m. Launch, February 24.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

Sat., April 25.—SOUTH EAST LONDON BRANCH: Visit to London Airport, 2.30 p.m.

Tues., April 28.—LONDON NATIONAL LECTURE: Lecture Theatre, Institution of Electrical Engineers, Savoy Place, London, W.C.2, "Electronic Equipment of Airfields," E. H. Bruce-Clayton, 6.30 p.m.

Thurs., April 30.—BRIGHTON, HOVE AND DISTRICT BRANCH: New Imperial Hotel, First Avenue, Hove, "Power Factor Correction," J. W. Fletcher, 7.30 p.m.

Fri., May 1.—BRISTOL AND WEST OF ENGLAND BRANCH: Grand Hotel, Bristol, "Plastics in the Electrical Industry," A. Walters, 8 p.m. ★ LIVERPOOL AND DISTRICT BRANCH: Industrial Development Centre, M.A.N.W.E.B., Paradise Street, Liverpool, 1, "The Use of Light in Combating Crime," Detective Chief Inspector Weeks, 7.30 p.m.

BRITISH INSTITUTE OF MANAGEMENT

Tues., April 28.—PRODUCTION CONTROL STUDY GROUP: Management House, Fetter Lane, London, E.C.4, "The Application of Computers to Production Control," J. Grant, 2.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Tues., April 28.—MEDICAL ELECTRONICS GROUP: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, Two papers on "Electron Microphony," G. Causey and R. S. Page, 6.30 p.m.

Fri., May 1.—SOUTH MIDLANDS SECTION: North Gloucestershire Technical College, Cheltenham, "Transistor Amplifiers," F. Butler, 7 p.m.

Tues., May 5.—LONDON SECTION: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, "An Experimental Diode Parametric Amplifier and its Properties," I. M. Ross, C. P. Lea-Wilson, A. J. Monk and A. F. H. Thomson, 6.30 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Thurs., April 30.—SOUTHERN REGION: St. Ermins Hotel, Westminster, London, S.W.1, "Economic Purchase of Coal for Small Plants," G. Armstrong, 10.30 a.m.

ILLUMINATING ENGINEERING SOCIETY

To-day, April 24.—BIRMINGHAM CENTRE: Regent House, St. Philip's Place, Colmore Row, Birmingham, "Lighting and Industry in the Soviet Union," E. H. Norgrove, 6 p.m.

Thurs., May 7.—CARDIFF CENTRE: Demonstration Theatre, South Wales Electricity Board, The Hayes, Cardiff, Open Forum on Lighting, 6 p.m. ★ NOTTINGHAM CENTRE: Electricity Service Centre, Nottingham. Annual General Meeting, 6 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

To-day April 24.—SLOUGH SECTION: Afternoon visit to British Bath Company, Ltd., Greenford.

Wed., April 29.—SOUTHAMPTON SECTION: Technical College, St. Mary's Street, Southampton, Annual General Meeting; "Application of Automatic Controls to Mould Production in Fully- and Semi-Mechanised Foundries," J. A. Hufton, 7.30 p.m.

INSTITUTE OF FUEL

Fri., May 1.—SOUTH WALES SECTION: South Wales Institute of Engineers, Park Place, Cardiff, Annual General Meeting, 6 p.m.

INSTITUTE OF MARINE ENGINEERS

Mon., April 27.—WEST OF ENGLAND SECTION: Grand Hotel, Bristol, Films, "Engineering at Calder Hall," "Criticality," and "Radio-Isotopes in Industry," 7.30 p.m.

INSTITUTE OF METALS

Wed., April 29.—POWDER METALLURGY JOINT GROUP: Church House, Great Smith Street, Westminster, London, S.W.1, Papers on "Theoretical Aspects of Sintering," 9.30 a.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., April 28.—Great George Street, Westminster, London, S.W.1, "A Project for Extending the Nigerian Railway into Bornu Province," Sir Ralf Emerson, 5.30 p.m.

Thurs., April 30.—NORTH WESTERN ASSOCIATION: Queen Hotel, Chester, Annual Branch Meeting, 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

To-day, April 24.—RADIO AND TELECOMMUNICATION SECTION: Savoy Place, London, W.C.2, "Engineering Aspects of Commercial Television Programme Presentation," T. C. Macnamara and B. Marsden, 5.30 p.m.

Mon., April 27.—RADIO AND TELECOMMUNICATION SECTION: Savoy Place, London, W.C.2, "The Field Strengths Required for the Reception of Television in Bands, I, III, IV and V," G. F. Swann, 5.30 p.m. ★ SOUTH MIDLAND RADIO AND MEASUREMENT GROUP: James Watt Memorial Institute, Birmingham, Annual General Meeting; "Stereophonic Sound," K. N. Hawke, 6 p.m.

Wed. April 29.—LONDON GRADUATE AND STUDENT SECTION: Visit to London Transport's New Signalling Installation at Rickmansworth and Watford, 2 p.m.

Wed. and Thurs., April 29 *and* 30.—Savoy Place, London, W.C.2, Meeting in conjunction with the British Nuclear Energy Conference, Convention on "Thermonuclear Processes," 5.30 p.m.

Mon., May 4.—SOUTH MIDLAND CENTRE: James Watt Memorial Institute, Birmingham, "Some Problems Associated with the Operation of Large Turbo-Alternators," A. Abbott, 6 p.m.

Tues., May 5.—MEASUREMENT AND CONTROL SECTION: Savoy Place, London, W.C.2, "Propagation of Electrical Signals along Nerve Fibres," A. L. Hodgkin, 5.30 p.m. ★ NORTH MIDLAND CENTRE: C.E.G.B. Offices, Leeds, Annual General Meeting, 6.30 p.m. ★ NORTH-WESTERN CENTRE: Engineers' Club, 17, Albert Square, Manchester, "Electrical Supplies to Power Station Auxiliaries," D. A. Dewison; Annual General Meeting, 6.15 p.m. ★ NORTHERN IRELAND CENTRE: David Keir Building, Queen's University, Stranmillis Road, Belfast, Annual General Meeting, 6.30 p.m.

Wed., May 6.—NORTH LANCASHIRE SUB-CENTRE: North-Western Electricity Board Demonstration Theatre, Friargate, Preston, Annual General Meeting; "Domestic High-Fidelity Reproduction," J. Moir, 7.15 p.m. ★ SOUTH-WEST SCOTLAND SUB-CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, Annual General Meeting, 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

To-day, April 24.—LONDON BRANCH: 1, Birdcage Walk, Westminster, London, S.W.1, Annual Meeting; Technical Film Show, 6 p.m. ★ LONDON GRADUATES' SECTION: All-day visit to de Havilland Engine Company, Ltd., Leavesden, Herts.

To-day and Sat., April 24 *and* 25.—EAST MIDLANDS BRANCH: Portland Building, The University, Nottingham, Spring Meeting.

Tues., April 28.—EDUCATION GROUP: 1, Birdcage Walk, Westminster, London, S.W.1, Discussion on "Extended University Courses for the Better Graduate," 6 p.m. ★ SOUTH WALES BRANCH: South Wales Institute of Engineers, Park Place, Cardiff, "South American Tour," B. G. Robbins, 6 p.m.

Wed., April 29.—INDUSTRIAL ADMINISTRATION AND ENGINEERING PRODUCTION GROUP: 1, Birdcage Walk, Westminster, London, S.W.1, Discussion on "Industrial Finishing," 6 p.m.

Wed., May 6.—SOUTHERN BRANCH: Visit to E.M.O. Instrumentation, Ltd., Bracknell, 2 p.m. ★ SOUTHERN BRANCH: Visit to Gypsum Mines, Mountfield, Robertsbridge, 2.30 p.m. ★ EASTERN GRADUATES' SECTION: Afternoon visit to Tube Investments Research Laboratories, Hinton Hall, Saffron Walden, Essex.

INSTITUTION OF PRODUCTION ENGINEERS

Mon., April 27.—NORTH WESTERN REGION: Manchester College of Science and Technology, Manchester, "Productivity in the Cotton Textile Industry," A. Ormerod, 7 p.m.

Wed., April 29.—1958 GEORGE BRAY MEMORIAL LECTURE: Assembly Hall, Royal Commonwealth Society, Northumberland Avenue, London, W.C.2, "The Search for Productivity in a Food Industry," Mark Bogod, 6.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Fri., May 8.—MIDLAND COUNTIES BRANCH: Department of Civil Engineering, The University, Birmingham, "Future Trends in Structural Engineering," S. C. Redshaw, 10 a.m. ★ NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institution, Middlesbrough, Symposium on "Structural Engineering"; "Flat Slab Concrete Structures," J. A. Derrington; "The Future of Steel Single Storey Buildings," R. A. Sefton Jenkins and, "The Development of Foundation Engineering," A. L. Little, 2 p.m.

JUNIOR INSTITUTION OF ENGINEERS

Fri., May 1.—Pepys House, 14, Rochester Row, Westminster, London, S.W.1, "A Peep Behind the Iron Curtain," G. V. Rickards, 7 p.m.

Mon., May 4.—12TH GUSTAVE CANET MEMORIAL LECTURE: Pepys House, 14, Rochester Row, Westminster, London, S.W.1, "Recent Developments in the Field of Heavy Steel Forgings," Paul Gaston Bastien, 7.30 p.m.

MANCHESTER STATISTICAL SOCIETY

To-day, April 24.—Portico Library, 57, Mosley Street, Manchester, "Unfair Queues," F. Downton, 6 p.m.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

To-day, April 24.—Lecture Theatre, Mining Institute, Newcastle upon Tyne, "Speed of Submerged Nuclear-Power-Driven Ships," J. A. Teasdale, 6.15 p.m.

PLASTICS INSTITUTE

Tues., May 5.—Wellcome Building, 183–193, Euston Road, London, N.W.1, Annual General Meeting; "Precision Cast Moulds and Tools for the Plastics Industry," C. Shaw, 6.30 p.m.

REINFORCED CONCRETE ASSOCIATION

Thurs., April 30.—WEST OF ENGLAND BRANCH: New School of Engineering, The University, Bristol, "Precasting in Concrete Framed Construction," J. F. Greining and R. Westbrook, 6 p.m.

ROYAL INSTITUTION OF CHARTERED SURVEYORS

Mon., May 4.—ORDINARY GENERAL MEETING: 12, Great George Street, Westminster, London, S.W.1, "The New Code of Compensation," P. G. E. Haddock, 5.45 p.m.

ROYAL SOCIETY OF HEALTH

Mon. to Fri., April 27 *to May* 1.—Royal Hall, Harrogate, Health Congress.

ROYAL STATISTICAL SOCIETY

Tues., April 28.—MEDICAL SECTION: London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, Discussion on "Matched Pairs," 5.30 p.m.

Thurs., April 30.—SHEFFIELD GROUP: Cavendish Room, Grand Hotel, Sheffield, Annual General Meeting, "A General Simulation Programme," K. D. Tocher, 7 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Wed., May 6.—CORROSION GROUP: 14, Belgrave Square, London, S.W.1, Annual General Meeting; Chairman's Address, S. G. Clarke, 6.30 p.m.

SOCIETY OF ENGINEERS

Mon., May 4.—Geological Society, Burlington House, London, W.1, "Grouting and Civil Engineering," D. J. Ayres, 5 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

Tues., April 28.—Manson House, Portland Place, London, W.1, "Measurements in the Photographic Industry," M. E. F. Howarth and P. B. Watt, 5.30 p.m.

Wed., April 29.—CHESTER SECTION: Lecture Theatre, Grosvenor Museum, Grosvenor Street, Chester, Annual General Meeting; Film Show, 7 p.m.

Wed., May 6.—Manson House, Portland Place, London, W.1, Annual General Meeting, 5.30 p.m.; Presidential Address, 6.30 p.m.

TELEVISION SOCIETY

Fri., May 8.—Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, London, W.C.2, Annual General Meeting, 7 p.m.

UNIVERSITY OF LONDON

Wed., April 29.—King's College, Strand, London, W.C.2, "The Gyrator as a Network Element," B. D. H. Tellegen, 5.30 p.m.

Thurs., April 30.—Imperial College of Science and Technology, City and Guilds College (Room 04), Exhibition Road, London, S.W.7, "The Search for a Complete Set of Ideal Non-Linear Network Elements," B. D. H. Tellegen, 5.30 p.m.

Advanced Engineering Courses

Operational Research. UNIVERSITY OF BIRMINGHAM, INSTITUTE FOR ENGINEERING PRODUCTION, 16, Norfolk Road, Birmingham, 15. The general purpose of the course is to enable industrial managers, senior production engineers and operational research and work study specialists, to meet together with leading authorities in the operational research field and to engage upon discussions and group studies on modern developments in the application of operational research to industrial productivity problems. The course will be held from 9.30 a.m. Monday, May 4, to 3.30 p.m. Friday, May 15. Fee for the two-week residential is 55 guineas.

Harwell Reactor School: Course for senior technical executives. REACTOR SCHOOL, ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, DIDCOT, BERKS. June 15 to 25. Fee, 50 guineas (exclusive of accommodation).

Control and Instrumentation of Reactors. REACTOR SCHOOL, ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, DIDCOT, BERKS. The course is primarily intended for those who have a direct interest in the control and instrumentation of nuclear reactors, and it will be assumed that participants have some knowledge of the basic principles of these subjects. The course runs from July 7 to 17 inclusive. Fee, 50 guineas (exclusive of accommodation).

Post-graduate Course in Nuclear Power, 1959–60. IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, LONDON, S.W.7. The course is intended for students holding a good honours degree in mechanical, civil, electrical or chemical engineering. It will also be open to applied scientists who have graduated in physics or metallurgy. The course is full-time and of one year's duration. Fee for the full course, £124. Applications should be made before July 1.

A NICKEL STORY

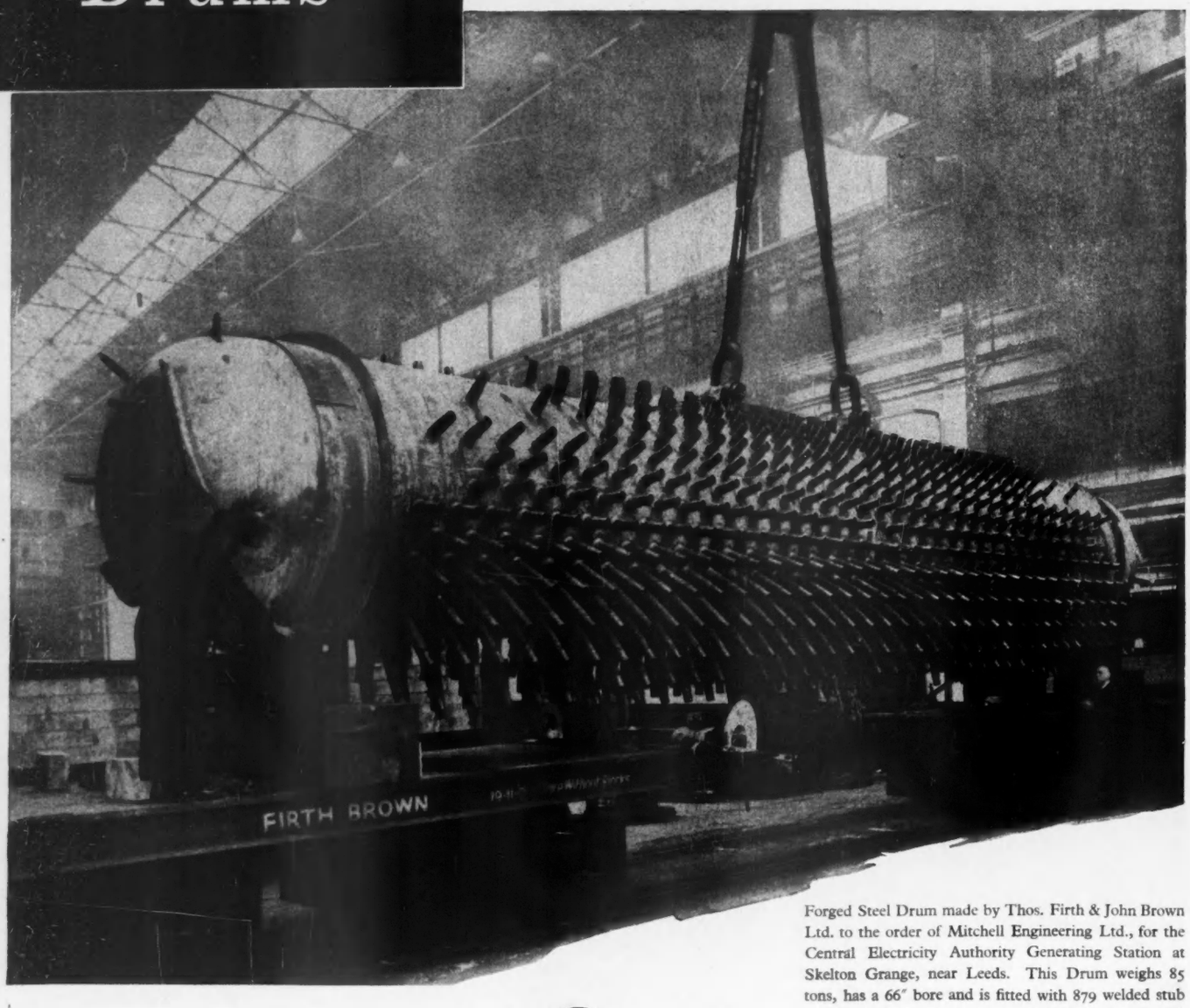
Pride of possession, as well as a face is reflected in the mirror finish of really good plating. For sound decorative chromium plating a nickel deposit approximately a hundred times the thickness of chromium is the only foundation which will give years of satisfactory service, against corrosion, rubbing and knocks. Ask Mond about this aspect of the nickel story. Mond have the resources for research and development and supply technical publications for guidance in the choice and use of modern materials.

Enough Nickel for all needs–

Plan ahead with **MOND NICKEL**

THE MOND NICKEL COMPANY LIMITED, THAMES HOUSE, MILLBANK, LONDON, S.W.1

Forged Boiler Drums



Forged Steel Drum made by Thos. Firth & John Brown Ltd. to the order of Mitchell Engineering Ltd., for the Central Electricity Authority Generating Station at Skelton Grange, near Leeds. This Drum weighs 85 tons, has a 66" bore and is fitted with 879 welded stub tubes and attachments to accommodate a design pressure of 1850 lbs/sq."

by

FIRTH BROWN

ALLOY STEELMAKERS · FORGEMASTERS · STEEL FOUNDERS · HEAVY ENGINEERS

THOS. FIRTH & JOHN BROWN LIMITED · SHEFFIELD · ENGLAND

BTR INDUSTRIAL HOSES are used by people who know . . .
No. 1: The Compressor and Pneumatic Tool Manufacturer
Look at this terrain — jagged, hard, abrasive granite, the worst kind of ground for dragging hose over. That's why the leading compressor and pneumatic tool manufacturers choose BTR Industrial Hose for this toughest of all jobs, granite quarrying. BTR pneumatic hoses have tough rubber covers that can stand up to granite, inner tubes that withstand disintegration from lubricating oil mist, and fabric ply reinforcement of extra strength for extra-heavy duty.

BTR Industries Ltd
BRITISH THERMOPLASTICS & RUBBER MANUFACTURERS
HERGA HOUSE, VINCENT SQUARE, LONDON S.W.1
BTR ENGINEERS IN RUBBER

1/2848

JUST PUBLISHED —

"A complete library in two volumes.."

KEMPE'S

Engineers Year-Book

Edited under the direction of the Editor of "The Engineer"

1959

(64th Edition)

82/6
(plus postage 2/6)

★ **3,000 pages covering modern theory and practice in all branches of engineering. No other single publication devoted to engineering covers a comparable range of subjects so concisely.**

•

ORDER YOUR COPY NOW

Obtainable direct from the publishers or through your local booksellers

Send for complete prospectus to:-

Kempe's Engineers Year-Book

28 Essex Street,
Strand, London, W.C.2

Telephone: Central 6565

Waste Heat Recovery Plant

Specialists in the design and construction of Steam-Raising Plant utilising waste gases, in the Gas, Chemical, and Ceramic Industries; also Iron, Steel and Non-Ferrous Metal Industries; Heat Recovery from internal combustion engines and similar prime movers in Land and Marine Installations. A direct method of increasing thermal efficiency and saving fuel.

Consult the Specialists in Waste Heat Recovery.

SPENCER-BONECOURT-CLARKSON LTD. 28 Easton St., London, W.C.1. *Tel: Terminus 7466*

SPECIAL MACHINES AND PROTOTYPES ARE OUR SPECIALITY

PRODUCTION and GENERAL MACHINING of CASTINGS and FORGINGS to 3 ft. Dia.

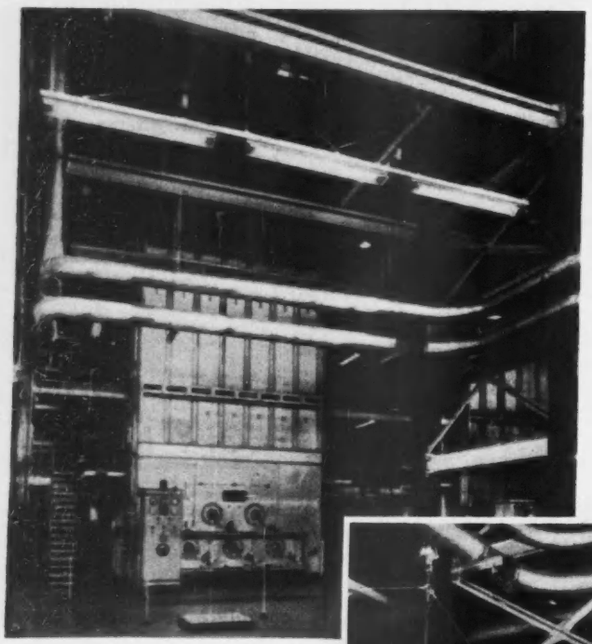
LET US QUOTE YOU . .

Photograph by courtesy of British Timken Ltd.

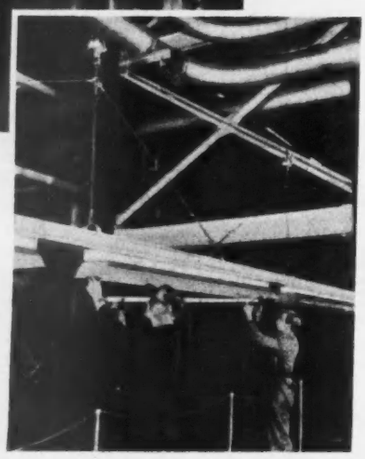
G. H. WHITEHOUSE & SON LTD.

THE ENGINEERS

Horseley Heath, Tipton, Staffs. Telephone Tipton 1145



Fluorescent Trunking in the boiler house at Vauxhall Motors, Luton.



Here the lights have been lowered by means of L.E.F. gear for servicing at a convenient height.

TIB 125

OUT-OF-REACH LIGHTING . . .

You need
L.E.F. Raising and Lowering Gear

When servicing lights, don't incur heavy labour costs and risk accidents with ladders and improvisations. With L.E.F. Raising and Lowering Gear lights can be quickly brought down to a convenient level and raised again when the work is finished. L.E.F. gear is suitable for both interior and exterior lighting — and soon pays for itself through lower maintenance costs.

We shall be glad to send you full details or give you a demonstration at our works.

. . . TO BE SERVICED ?

LEF

LONDON ELECTRIC FIRM LIMITED

Brighton Road, South Croydon, Surrey.

Telephone: Uplands 4871

THIS is the compressor that costs less to maintain: the "Power Vane" Rotary. The essential simplicity of the rotary principle, pioneered by Consolidated Pneumatic, means that there are not only fewer parts to service (no valves, pistons, clutch or crankshaft) but also fewer replacement parts to stock. Oil-flood lubrication further reduces wear to a minimum, making "Power Vane" Rotary compressors good for long, continuous running without major attention. "Power Vane" Rotary compressors deliver pulsation-free, *cool* air in volumes from 125 to 600 c.f.m. F.A.D. For full details of all models, ask for Catalogue No. 58.

POWER VANE ROTARY COMPRESSORS

Cost less to maintain

CP185

MANUFACTURED BY Consolidated Pneumatic

CONSOLIDATED PNEUMATIC TOOL CO LTD · DAWES ROAD · LONDON · SW6

High Speed Assembly

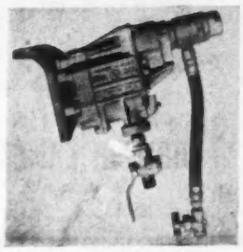
Repetition Nut and Bolt Work with Impact Wrenches

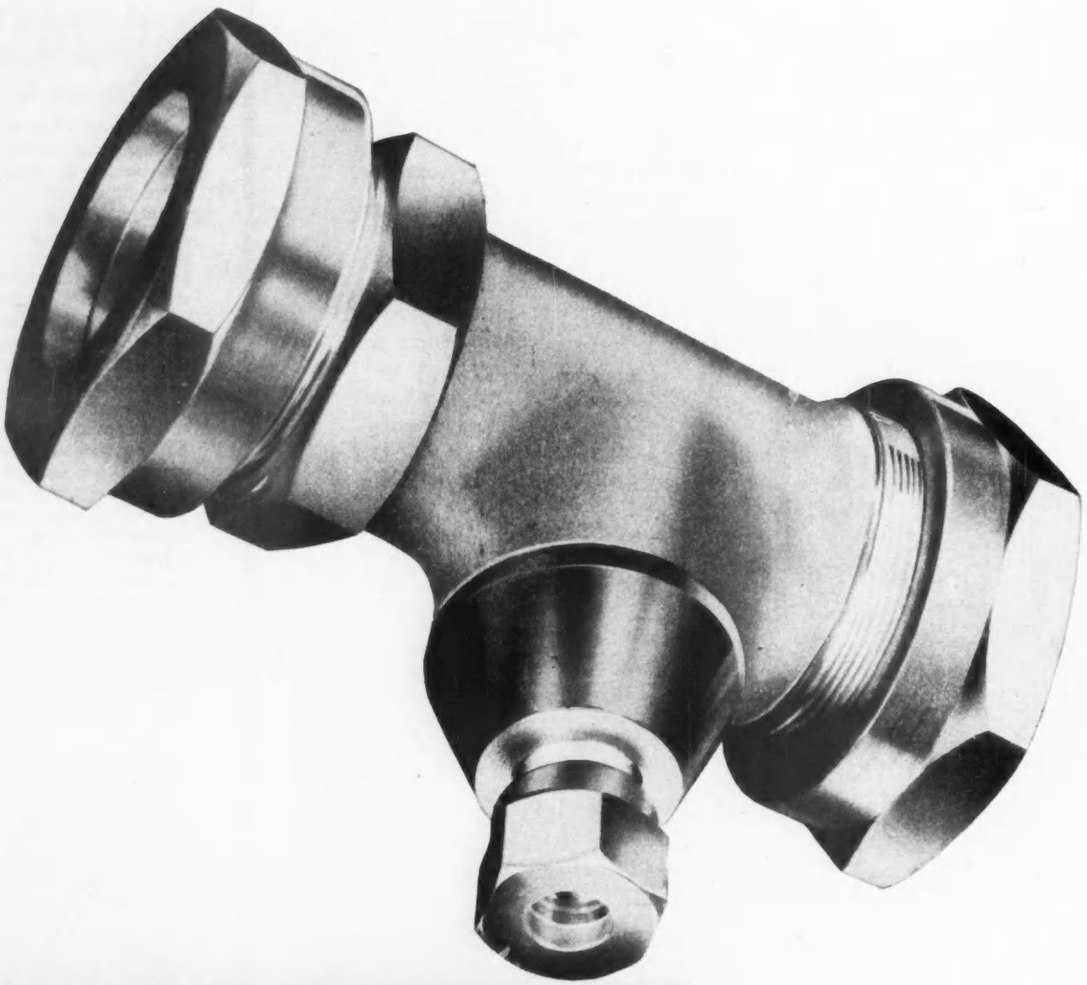
Any assembly or dis-assembly of a repetition nature, which involves nuts and bolts, will reveal an outstanding speed-up of work by the introduction of the impact wrench. Each size and position of bolt will, of course, need the right model to deal with it, and it is here that the really comprehensive selection of wrenches from the CP range will fulfil any need. From a tiny tool weighing little more than 2-lb for $\frac{1}{4}$" bolts to a large, powerful, yet single-handed tool tackling $1\frac{3}{4}$" bolts, this big CP selection is the finest available and includes many angle models.

CP wrenches are ideal, too, for plant maintenance and repair work, since their power will remove the most stubborn of nuts in a matter of seconds, irrespective of rusting or burring of threads. The type of service which CP impact wrenches will give to industry extends to an ever-growing list of operations including stud running, screwdriving, and tapping. CP representatives will be pleased to advise on their applications, and literature is freely available on request.

Wet Rotary Drilling

The powerful No. 327 pneumatic coal drill designed for wet drilling has a forward water feed giving unrestricted flow through the drill rod without leakage back to the operator. This tool is available as a dry model and in both versions there is a choice of speeds. CP boring tools include electric models which can also be fitted with wet drilling attachment.





Expressly designed

During the past twenty years, ERMETO designers have developed an immense range of high pressure fittings to suit every conceivable need. If our range does not contain a fitting to suit your purpose do not hesitate to contact us. Our technical staff will be pleased to collaborate in the development of any non-standard item.

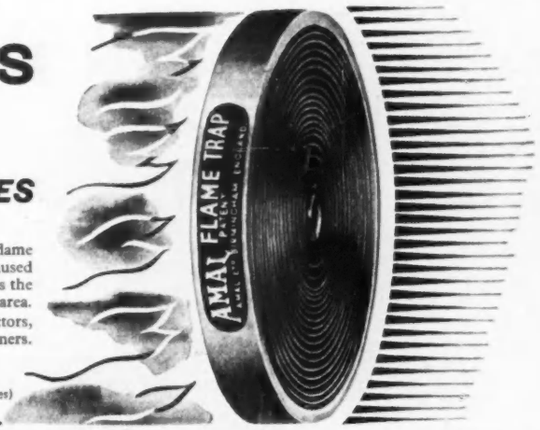
ERMETO
REGD TRADE MARK

Details of our standard range of high pressure valves and couplings are available on request.

BRITISH ERMETO CORPORATION LTD., Beacon Works, Hargrave Rd., Maidenhead, Berks.
Telephone: Maidenhead 5100 (10 lines)

AMAL FLAME TRAPS

FOR SEWAGE AND OTHER INDUSTRIAL GASES



● Flame Traps for fitting into pipe lines carrying an explosive air-gas mixture will hold the flame for a limited period until a cut-off valve comes into operation. Little resistance to the flow is caused by the use of these traps. List No. 526 describes various models and gives the pressure drop for various flows per square inch effective trap area.
Also AMAL Bunsen Burners for laboratory and industrial use; Injectors, and Calibrated Jets for fitting into burners.

Enquiries to:—
AMAL LIMITED, HOLDFORD ROAD, WITTON, BIRMINGHAM, 6 *'Phone: Birchfields 4571 (5 lines)*

A.352

The Nitriding Process for Case-hardening Special Steels by Nitrogen offers

- **Surface hardness up to 1100 D.P.H.**
- **Retention of full hardness after heating to 500°C.**
- **Maximum resistance to frictional wear and fatigue.**
- **Improved resistance to corrosion by water and steam.**

Particulars from:—
NITRALLOY LIMITED
ATLAS WORKS SHEFFIELD, 4.
Telephone: Sheffield 26646. Telegrams: "NITRALLOY, SHEFFIELD."

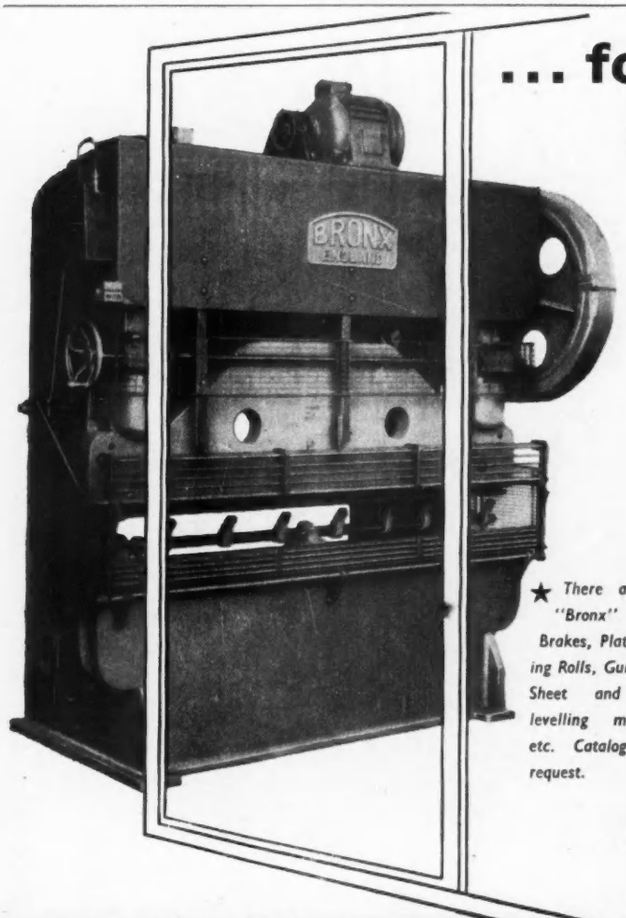
absterge

(to clean by wiping)

Austins supply the best cleaning rags for every purpose. Some jobs call for coarse, heavy fabric, some for soft, closely woven materials—we can meet all requirements with carefully selected rags that are thoroughly washed and sterilised in our own plant. Orders of all sizes are handled with promptness and reliability. Please let us quote you for regular supplies.

AUSTINS industrial cleaning rags

E. AUSTIN & SONS (LONDON) LTD., GUN WHARF, GUNMAKERS LANE, E.3 · Tel: ADVance 1211



... for Punching and Notching METAL WINDOW BARS

This machine has been developed from the well-known Bronx 60-ton Press Brake, and incorporates an 8ft. long beam, which has a stroke of 3½in. and a vertical adjustment of ⅝in., by hand, through worm gearing. A distance of 7in. is provided between the beam and the bed, with the stroke down and adjustment up. The operating speed is 40 strokes per min. and the cycle is automatically started by the action of closing the guard by hand. A stroke counter and a dial indicator, which shows the bottom dead-centre position of the beam, are fitted.

★ *There are also "Bronx" Press Brakes, Plate Bending Rolls, Guillotines, Sheet and Plate levelling machines, etc. Catalogues on request.*

BRONX

GANG PUNCHING PRESS

BRONX ENGINEERING CO. LTD., LYE, WORCESTERSHIRE TEL: LYE 2307/8

72

G·G·L

We all know this man. He's the chap who has just tried GGL for the first time and can't stop talking about the wonderful quality and service. He's a nice man, really, but he does go on . . . and it isn't as if we old stagers didn't rely on GGL service, too.

CAPSTAN AND AUTOMATIC WORK AND SHEET METAL PRESSING IN ANY METAL, ANY FINISH, ANY QUANTITY

FOR QUICK SERVICE AT THE RIGHT PRICE GET IN TOUCH WITH:

GRIFFITHS, GILBART, LLOYD & CO. LTD.

EMPIRE WORKS, PARK ROAD, BIRMINGHAM, 18

TEL: NORTHERN 6221

The Crockatt VALVE RESEATER

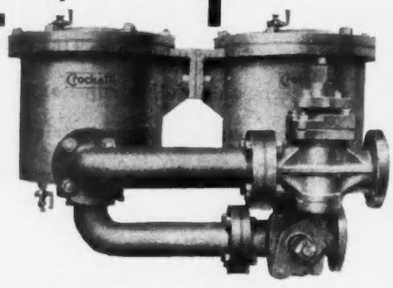
saves steam—saves time

The Crockatt Valve Reseater is operated by one man and is self-centring in the valve chest. Suitable for flat or mitred seats and quickly adjustable. Makes a true face, free from knurling WITHOUT DISTURBING THE PIPELINE. Moderately priced. Delivery from stock.

The Crockatt FEED WATER FILTER

removes impurities

Also: Electric Salinometers, Boiler Tube Brushes, Floor Sanders, Terrazzo Surfacers, etc. List on request.



The Crockatt Feed Water filter removes suspended impurities such as oil, grease, etc., from the feed water. Filter mats quickly changed for cleaning. High or low pressure as required in sizes up to 5" bore. Quick delivery.

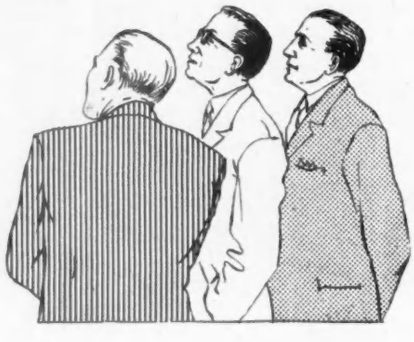
W. CROCKATT & SONS LTD **64 DARNLEY STREET GLASGOW, S.1**

Finished machined forgings

a h ! y e s

Cull forgings are good — really good. That cuts machine costs to a minimum — as they have a real understanding of the 'out-of-the-ordinary' job. Yes get in touch with Culls — they're the best people.

The forgings illustrated were finished machined at Cull's own factory, after final heat treatment and were subjected to crack detection. Cull inspection is 100% on all products.



CULL

W. B. CULL & SONS LTD.

Head Office & Works

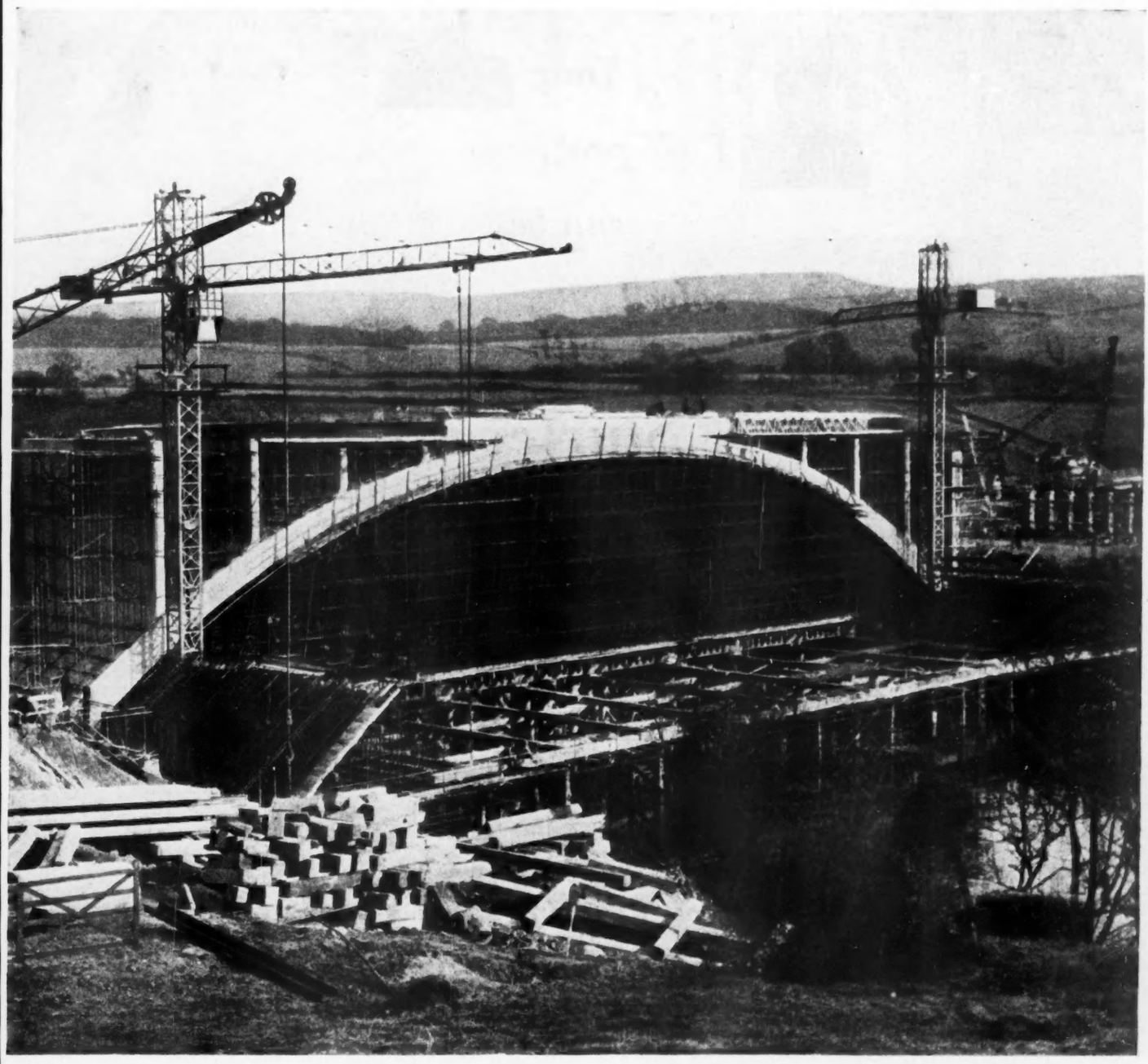
TENNANT STREET, BIRMINGHAM, 15

Phone: MIDland 6048-9 **Grams: CULANSONS, B'HAM**

Works also at:

POWKE LANE, OLD HILL, STAFFS.

if its different then send it to Culls"



Photograph by courtesy of James Drake, B.Sc., M.I.C.E., M.I. Mun. E., County Surveyor and Bridgemaster

The Lune Bridge...

. . . carrying the twin carriageway of the Lancaster By-Pass over the River Lune is just one of the 27 road and railway bridges included in the 11.62 miles of the Lancaster By-Pass. This work is being undertaken by Sir Lindsay Parkinson & Co. Ltd. for the Ministry of Transport and Civil Aviation through the Lancashire County Council at a contract value of £3,250,000.

SIR LINDSAY PARKINSON & CO. LTD.

6 LAMBETH ROAD, ST. GEORGE'S CIRCUS, S.E.1.

And in Australia, British Guiana, Canada, Cyprus, Ghana and India.

Your

FAN problems

can be

solved

with

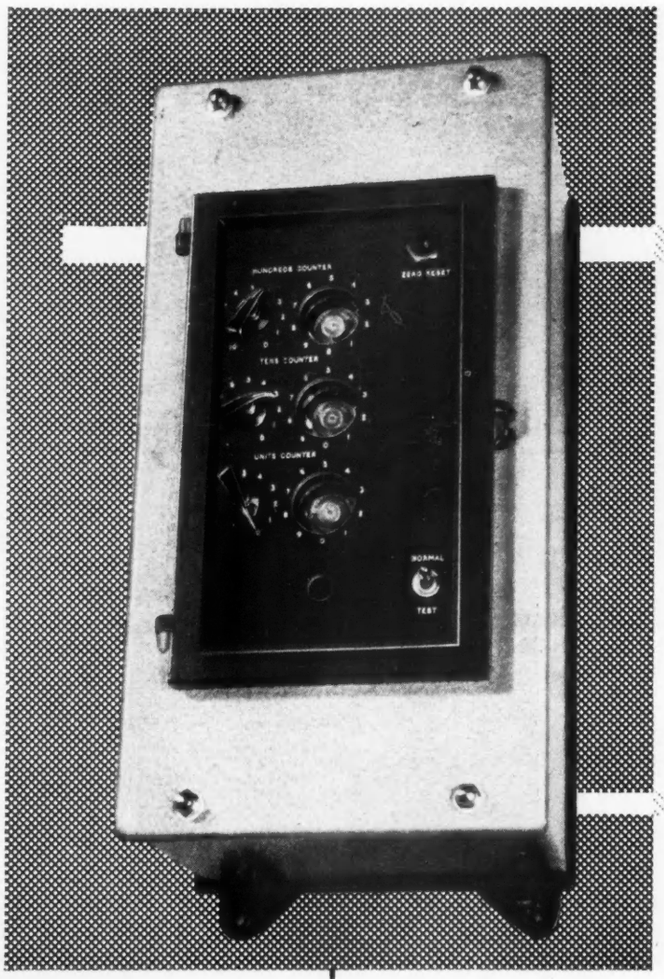
Sturtevant Stock Standard Fans

Write for our publication E2207, which describes fans for a wide range of applications and includes comprehensive data and drawings covering speeds, powers, weights and capacities.

STURTEVANT ENGINEERING CO. LTD.
Southern House, Cannon Street, LONDON, E. C. 4.

AUSTRALIA: STURTEVANT ENGINEERING CO. (AUSTRALASIA) LTD. 400 SUSSEX STREET SYDNEY N.S.W.

CHARLES D. HOLMES & CO. LTD.,
HULL ENGINEERING WORKS ALFRED STREET HULL
Telegrams: "COMPOUND HULL" Telephone: 16053 (3 lines)



SMITHS

Stand 34 Engineering, Marine Exhibition, Olympia, April 16—30

For Good Measure

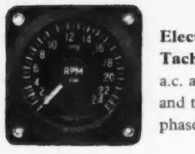
To Industry, the name SMITHS has a world of meaning. It includes a reputation for Good Measure, good measure in the sense of the long-term accuracy of their industrial instruments, good measure in terms of the service offered by unrivalled research and test facilities. This latter may be said to be immeasurable.

Transistor Batch Counter

This compact unit is used for the counting of articles into predetermined batches. It operates from a perception head which can be either a photo-electric cell and lamp, an electro-magnetic pick-off, or electro-mechanical switch. The counter resets automatically on completion of batch and at the same time an electrical signal is provided which can be used for a variety of functions.

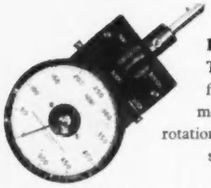
The Batch Counter, fully transistorised, consists basically of an amplifier, the necessary number of dekatron counting units, together with the coincidence and relay units. Built on the individual 'brick' principle which facilitates servicing, the Counter has general reliability and robustness ideal for industrial conditions.

Major overhaul cycle of several years.



Electric Tachometers a.c. and d.c. and three phase

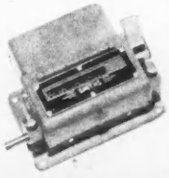
"Petro-flex" Flexible Tubing for the conveyance of all non-acid fluids



Hand Tachometers for the measurement of rotational, linear and surface speeds

Synchronous Hours Counters for indicating life of equipment in a.c. circuits

Calibrated Relays for the control of voltage current and speed to ±1% accuracy.



Pre-determined Counters for counting preset quantities

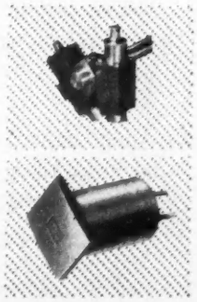


Photo-electric cell and lamp arranged for reflected-light operation; this can be varied for interrupted-light operation.

Electro-magnetic pick-off is mounted to suit application.

For Good Measure in Industrial Instruments specify SMITHS

WRITE NOW FOR INDIVIDUAL LEAFLETS

AP 382

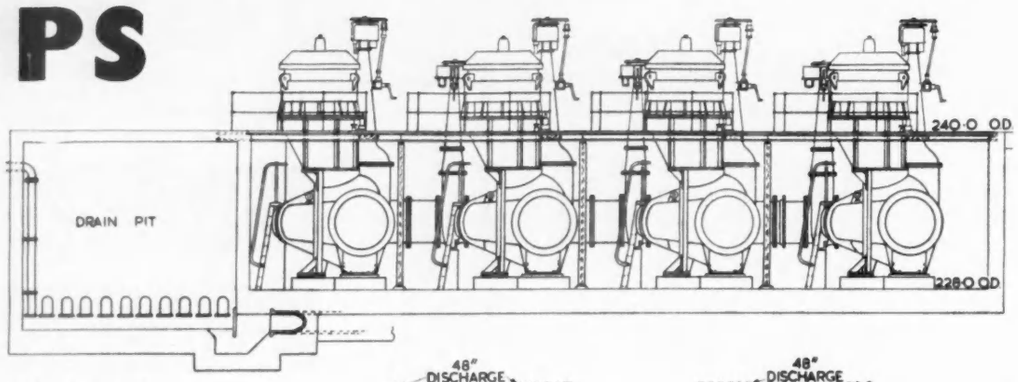
SMITHS INDUSTRIAL INSTRUMENT DIVISION

Chronos Works, North Circular Road, London, N.W.2. Telephone: GLAdstone 1136

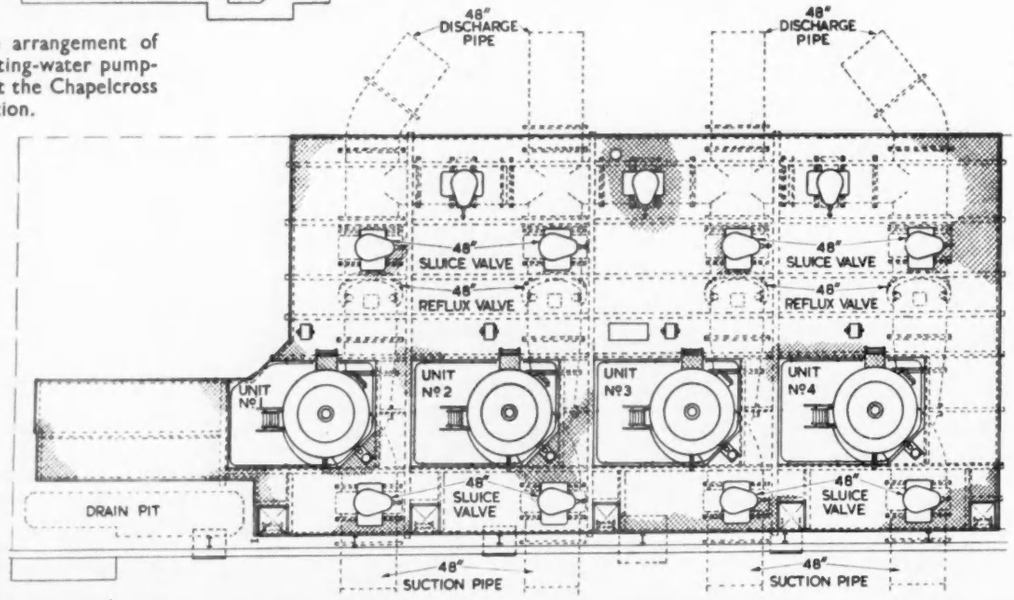
K

ALLEN PUMPS

CIRCULATING-WATER



Installation arrangement of the circulating-water pumping units at the Chapelcross Power Station.



for the

CHAPELCROSS POWER STATION of the UNITED KINGDOM ATOMIC ENERGY AUTHORITY

Consulting Engineers : MERZ AND MCLELLAN

The installation comprises four Allen 48/48-in. vertical double-suction centrifugal pumps, each designed to deliver 50,000 gallons of water per minute against a total head of 67 feet, running at a speed of 490 r.p.m., and driven by a 1225-h.p. L.S.E. motor.

Allen centrifugal and mixed-flow pumps, horizontal or vertical, are designed to meet all requirements up to the largest capacity units needed in modern power station service.

Also for power station pumping applications, Allen-Stoeckicht patented double-helical epicyclic gearing offers a very compact and low-weight speed-reduction or speed-increasing arrangement to suit all powers and speed ratios.

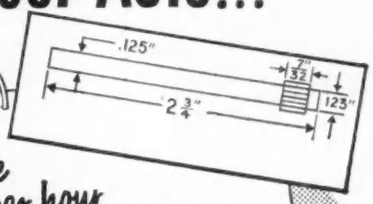
Specialists in complete Pumping Plant installations

W. H. ALLEN SONS & Co LTD

BEDFORD ■ ENGLAND

Stand No. 1, Row D, GRAND HALL : THE ENGINEERING, MARINE, WELDING AND NUCLEAR ENERGY EXHIBITION, OLYMPIA

79% Production Increase from Your Auto...



Conventional Auto Time 540 per hour

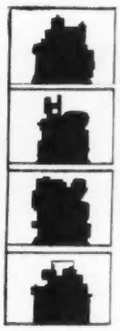
'LIPE' Time 969 per hour!

LIPE PNEUMATIC

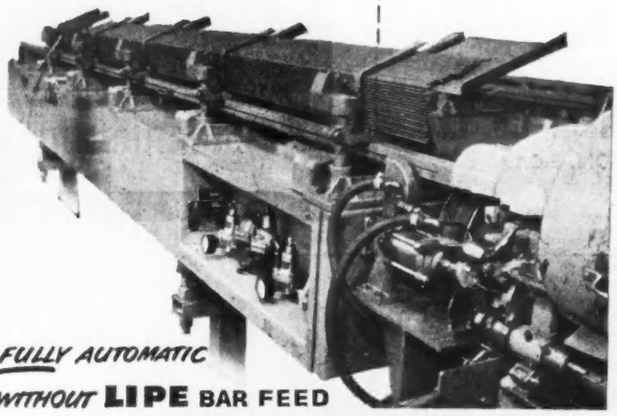
LET US ESTIMATE SAVINGS ON YOUR EXISTING RUN

* Only 4 seconds reloading.
* No idle time, continuous running.
* Proved in use, one operator handles several machines.
* Feeds to last workpiece — without fingers.
* Ejects remnant automatically.
* Range covers 1/16" to 1¼" bar, 1/8" to 1½" tube.

AUTOMATIC BAR FEED



THERE'S A **LIPE** FOR MOST BAR FED MACHINES



* YOUR AUTO IS NOT FULLY AUTOMATIC WITHOUT **LIPE** BAR FEED

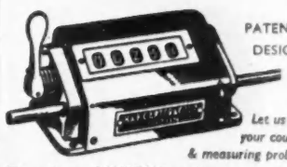
NEW LEAFLET JUST PUBLISHED write Dept. E.2555

Patents Nos. 728898 and 743461, 23176/57 and 10916/58.

Automation Ltd.
DEVONSHIRE HOUSE VICARAGE CRESCENT LONDON S W 11
PHONE: BATTERSEA 5549

NRP 2555

ALBION
Ratchet and Revolution Counters



PATENTED DESIGN

Let us solve your counting & measuring problems

There is an 'ALBION' ratchet or revolution counter for every application. Fit your machines with these efficient counting instruments which will show your output at a glance.

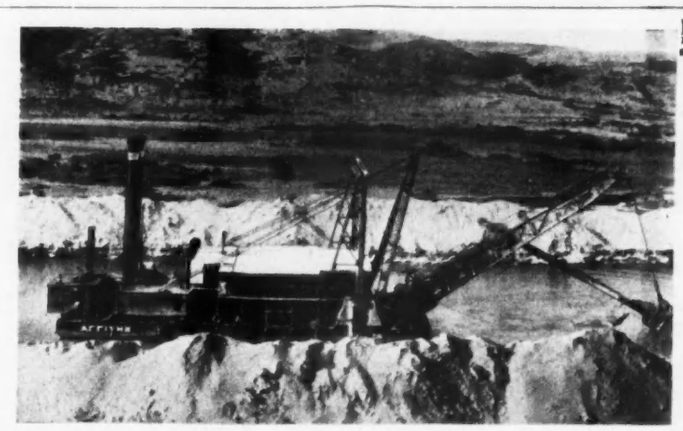
INSTRUMENT DIVISION
B. & F. CARTER & CO. LTD.
BOLTON 3, ENGLAND
'Phone: BOLTON 4344 (3 lines)
'Grams: BRAIDERS BOLTON

WOVEN WIRE
F. W. POTTER & SOAR LTD

Made in **ALL METALS**,
Our range of Weaving covers all grades from the **FINEST WIRE CLOTH** to the **HEAVIEST SCREENING**.
A.I.D. and **A.R.B.** approved

Please write for our Brochure, containing useful Technical information.

PHIPP STREET LONDON E.C.2



6-yard oil-fired Steam Dipper Dredger, built for the Greek Government. Output 255 cubic yards of cobbles and boulders per hour dumped to a radius of 90 feet and a clear height of 30 feet.

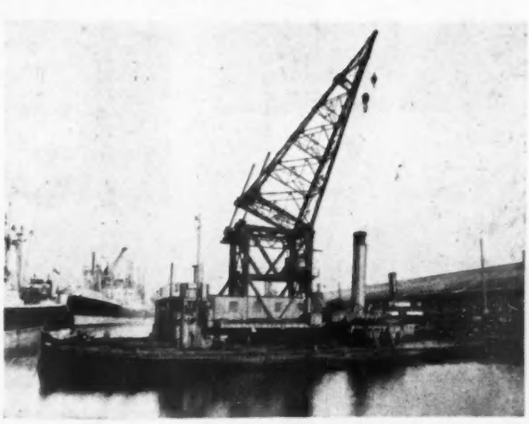
DREDGING PLANT

to the Largest Dimensions and Capabilities.

PATENT CUTTER HOPPER DREDGERS, PATENT DIPPER DREDGERS, BUCKET DREDGERS, GOLD & TIN RECOVERY DREDGERS, FLOATING CRANES

Hopper Barges
Screw Steamers,
Side and Stern Paddle Wheel Steamers, Tugs, etc.

New Buckets, Links, Pins, Gearing etc., supplied for existing Dredgers



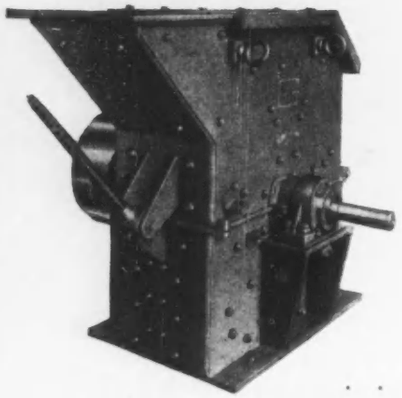
Crane Steamer M.O.W.T.8 built for Ministry of War Transport. Dimensions: 173 feet by 57 feet by 12 feet 6 inches. Load: 60 tons at 80 feet radius.

FLEMING & FERGUSON LTD.

Phone: Paisley 4121. SHIPBUILDERS & ENGINEERS, PAISLEY, SCOTLAND. *Tel. Add.: "Phenix Paisley."*
London Office: 54-62 REGENT STREET, W.1. *Phone Regent 6247*

LIGHTNING

HAMMER CRUSHER



FOR EITHER CUBICAL GRANULATION OR PULVERISATION

. . . Consult us with your crushing problems. Our 50 years' experience readily placed at your service without obligation.

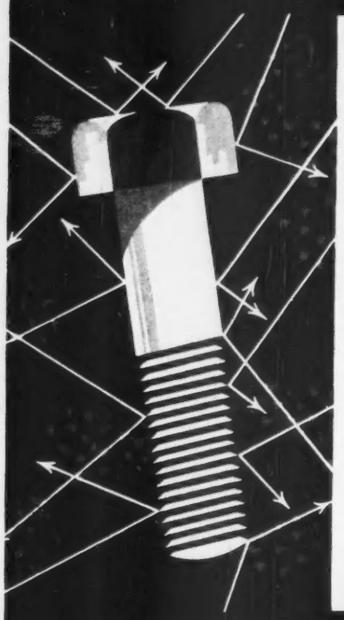
OBTAIN OUR BOOKLET

The Patent Lightning Crusher Co. Ltd.

14a ROSEBERY AVENUE, LONDON, E.C.1.

Phone: TERMINUS 1928

WHY FIGHT CORROSION?



Most chemical firms in this country spend a good deal of time and money in preventing corrosion of expensive process plant. And to little purpose, for corrosion has an uncanny habit of defeating even the most careful measures.

What's the answer? Well you can economise most decidedly in one respect: standardise on stainless steel nuts, bolts and setscrews. Stainless steel stands no nonsense from most forms of chemical corrosion. It stays bright and clean throughout the life of the equipment.

Nor need this be expensive. Stainless steel nuts and bolts from LANARKSHIRE are hot forged but bright finished — the cheapest production method by far. Naturally, base material is the best — EN58B or EN58J. And naturally, you can have ex stock delivery from LANARKSHIRE in sizes from $\frac{1}{4}$" dia. upwards to B.S. 1083, 2708 and 1769. Studs and stud bolts also supplied.

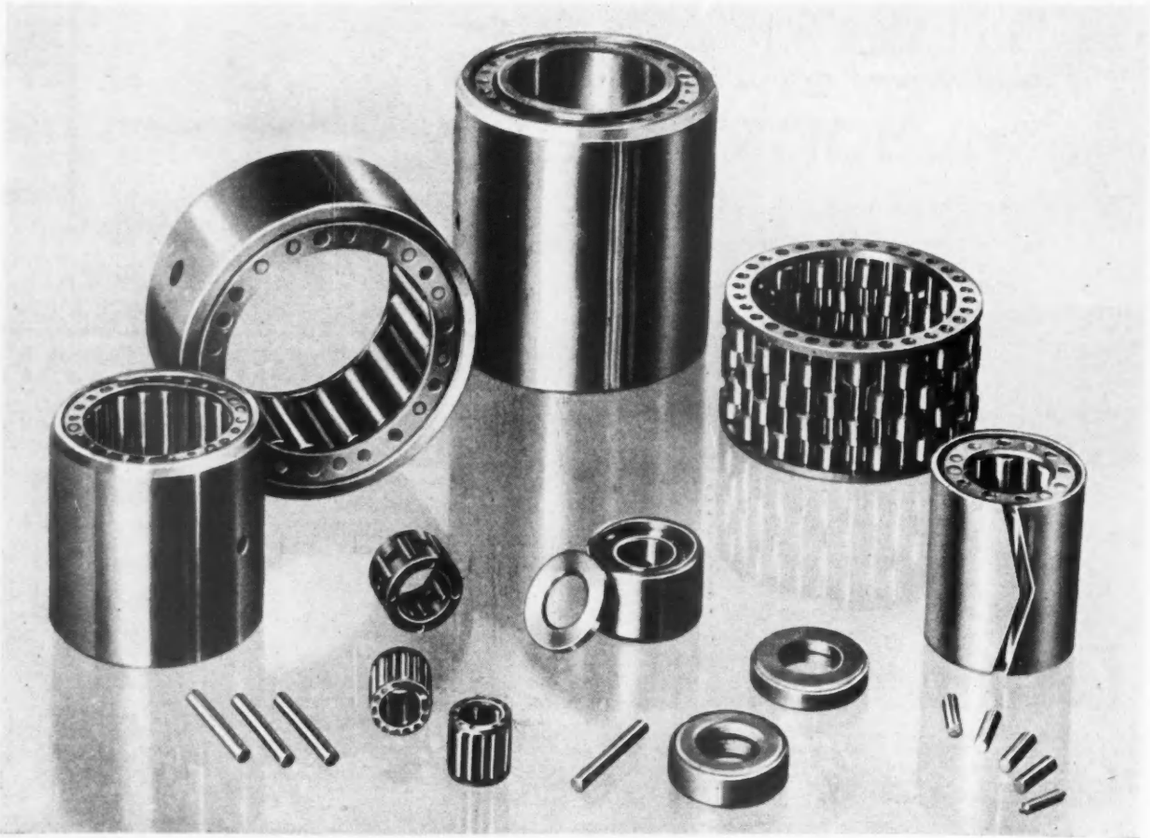
Please write for monthly stock list from

LANARKSHIRE BOLT LIMITED

HAMILTON · LANARKSHIRE SCOTLAND

Tel: Hamilton 1241-4

Send today for Comprehensive Catalogue



Blackwell Bearings Ltd. TEWKESBURY, GLOS., ENGLAND *Telephone:* TEWKESBURY 2018-9 *Telegrams:* WINWELL

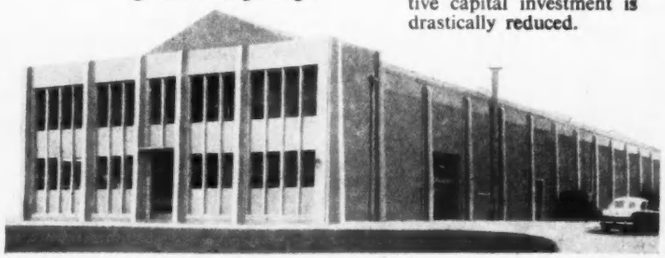
These buildings went up faster—

This announcement is of vital interest to you.
It's news—news of price reductions in a period of rising costs.
It can make that building project you may have scheduled for the future an economic proposition

NOW!

HERE'S WHY

- Advanced techniques eliminate all waste and delay.
- Firm quotations are given at design stage.
- Work commences on site months earlier.
- Construction frequently completed in half the average time.
- The period of unproductive capital investment is drastically reduced.



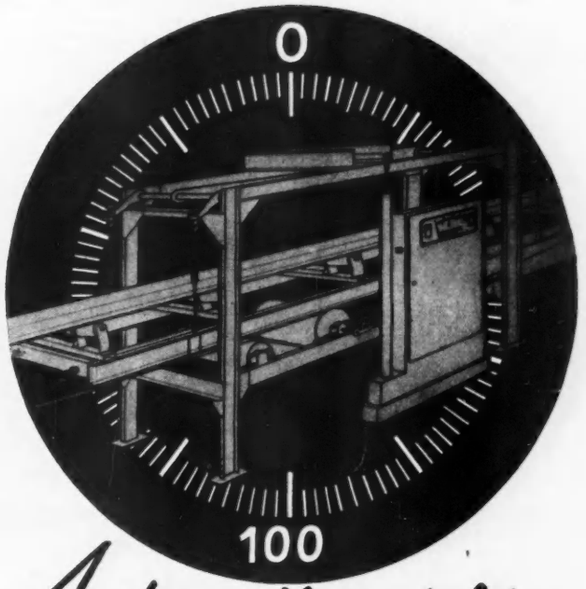
And you get a building of better quality at a lower cost!

Beecham Buildings

Beecham Buildings,
a quick return for your capital
Write or telephone today:

BEECHAM BUILDINGS LIMITED

Shipston-on-Stour, Warwickshire. Tel. Shipston-on-Stour 318 (6 lines)



Automatic weighing and conveying

by Automatic Weighing-Machines with electrical load recording. Railway Truck Weighbridges, Road Truck Weighbridges, special designs for industrial requirements and many other types of weighbridges

DUSSELDORFER WAAGEN- U. MASCHINENFABRIK
ED. SCHMITT & CIE. G. M. B. H.
DUSSELDORF-GERMANY-P. O. B. 11127

that the men in this picture are showing how a game of marbles is started?

Do you know, too, that anything new in welding is sure to be found in "SIF-TIPS"? You can make certain of receiving the magazine regularly by filling in the coupon.

THE EDITOR, "SIF-TIPS"
SUFFOLK IRON FOUNDRY (1920) LTD.,
STOWMARKET, SUFFOLK.

Please send
regularly . . . . copy/copies of "SIF TIPS"

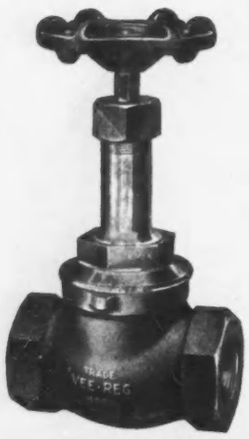
NAME _____

_____

ADDRESS _____

_____

_____ ENG4



VEE - REG

Regulating/Stop

GLOBE VALVES

FITTED WITH
'V' PORTED STAINLESS
STEEL CLACK & SEAT

• • •

In Bronze & Steel for Pressures up to 900 P.S.I. and 900° F.

• • •

WRITE FOR CATALOGUE TO :—

THE BRITISH STEAM SPECIALTIES LTD.
FLEET STREET
LEICESTER

FORGED STEEL PIPE FITTINGS

Screwed A.P.I., B.S.T.P.T. or socket weld. Materials: Carbon steel, chrome molybdenum or stainless steel.

C.W.P. non-shock
2000 lbs series
3000 lbs series
6000 lbs series

FORGED STEEL UNIONS

Integral seats or inserted stainless steel, chrome molybdenum or bronze.

WALTER SLINGSBY
& CO. LTD.

RAILWAY WORKS, KEIGHLEY

'Phone: 3749 'Grams: "Malleable Keighley."

Don't risk a break down

Auchterlonie Improved Plummer Blocks are permanently sealed and lubricated, thus standing up indefinitely to every strain and demand. There is no need to dismantle before fitting the Auchterlonie Plummer Block. *Write for Transmission Catalogue T.4*

CHAS. AUCHTERLONIE & CO. LTD
32 Station Road · New Southgate · London N11 *Telephone: ENTerprise 6222 7132*

RINGELMANN ZERO

IS YOUR NUMBER

WITH THE

OLDBURY chain grate STOKER

Developed in 1942 for versatility in burning the widest variety of solid fuels, efficiently, smokelessly, the Oldbury Stoker anticipated the Clean Air Act by 16 years.

It is your guarantee of absolutely smokeless combustion—RINGELMANN O—with full boiler output, no matter what fuel hazards may develop in the future.

Send for Publication No. 1618/2

EDWIN DANKS & CO. (Oldbury) LIMITED

OLDBURY near BIRMINGHAM. Telephone: (Stoker Division) Brierley Hill 7731

London · Birmingham · Cardiff Glasgow · Leeds · Manchester · Newcastle on Tyne

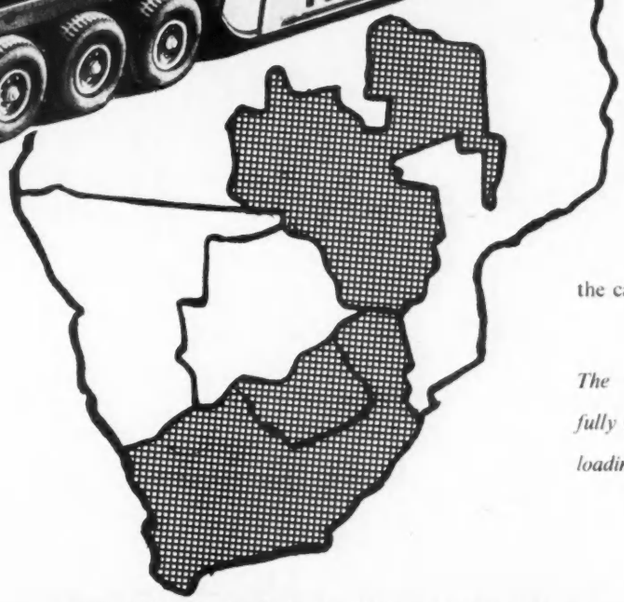
AVAILABLE *NOW!*

100-TON TRAILERS FOR TRANSPORTING HEAVY OR LARGE INDIVISIBLE LOADS IN THE

UNION OF SOUTH AFRICA

AND THE

FEDERATION OF RHODESIA & NYASALAND



The availability of these trailers now makes possible the transport by road in S. Africa and Rhodesia and Nyasaland of loads above the capacity of anything previously possible.

The trailers are designed so that when fully laden local regulations governing bridge-loading, etc., are complied with.

These special hydraulically suspended trailers were built by Cranes (Dereham), Ltd., Dereham, Norfolk, England. Manufacturers of trailers and semi-trailers for any load from 2 to 200 tons.

The trailer illustrated is carrying one of the 60MVA, 330kV transformers supplied to the Kariba Hydro-Electric Scheme by Ferranti, Ltd.

SPECIALLY DESIGNED AND BUILT BY

CRANES (Dereham) LTD.

OPERATED BY: **THORNTONS' TRANSPORTATION LTD.**

Please write for further particulars.

IN THE UNION OF SOUTH AFRICA
THORNTONS' TRANSPORTATION LTD
P.O. BOX 769
JOHANNESBURG, S.A.

IN THE RHODESIAS AND NYASALAND
THORNTONS' TRANSPORTATION RHODESIA (PVT) LTD.
P.O. BOX 2338
SALISBURY S. RHODESIA

WT/CT

275-kV TRANSFORMERS BY BTH

1951

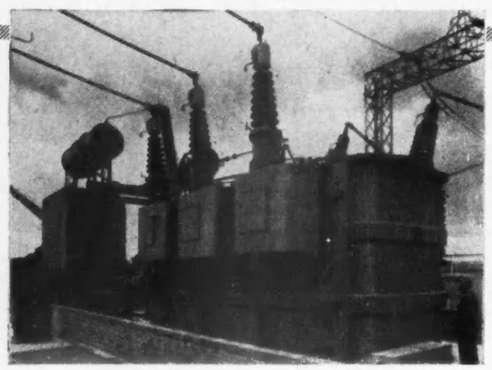
120 MVA UNDER CONSTRUCTION

BTH were first to be awarded a contract for the supply of 120-MVA 275/132-kV transformers for the C.E.G.B. Super Grid.

1953

120 MVA IN SERVICE

The first 120-MVA unit was commissioned in July 1953. Up to date, ten of these units have been installed or are on order.



120-MVA 275/132-kV transformers at the Staythorpe Sub Station of the C.E.G.B.

NOW

Another step forward

180-MVA ORDER IN HAND

C.E.G.B. placed with BTH one of the first two orders for 180-MVA 275/132-kV transformers

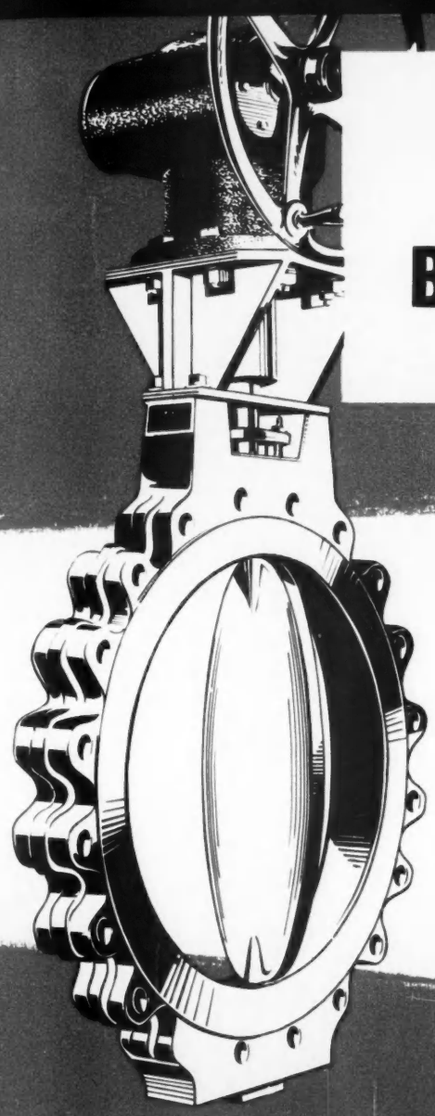
B T-H **BRITISH THOMSON-HOUSTON**

THE BRITISH THOMSON-HOUSTON COMPANY LIMITED · RUGBY · ENGLAND

an A.E.I. Company.

A5298

NOW manufactured in Britain



COCKBURN-ROCKWELL
HEAVY-DUTY
BUTTERFLY-VALVES
including WAFER-DESIGNS

Rockwell Heavy Duty Butterfly Valves are now manufactured under licence in Britain by Cockburns of Cardonald. These Valves provide wedge-tight shut off for steam gas or fluid at pressure differential to 150 p.s.i.

- **Positive Control for a wide range of applications.**
- **Easy installation with small face-to-face dimensions.**
- **Low first cost.**
- **Wide range of operating mechanisms.**
- **Made of any metal with any lining, for any operation pressure, temperature and flow conditions.**
- **Minimum restriction to flow and pressure drop. Rigid shakeproof assembly eliminates vibration and friction.**

A special design Butterfly Valve for high temperature applications. The special seating ensures leak tight closure at temperatures up to 1600° F.

COCKBURNS VALVES

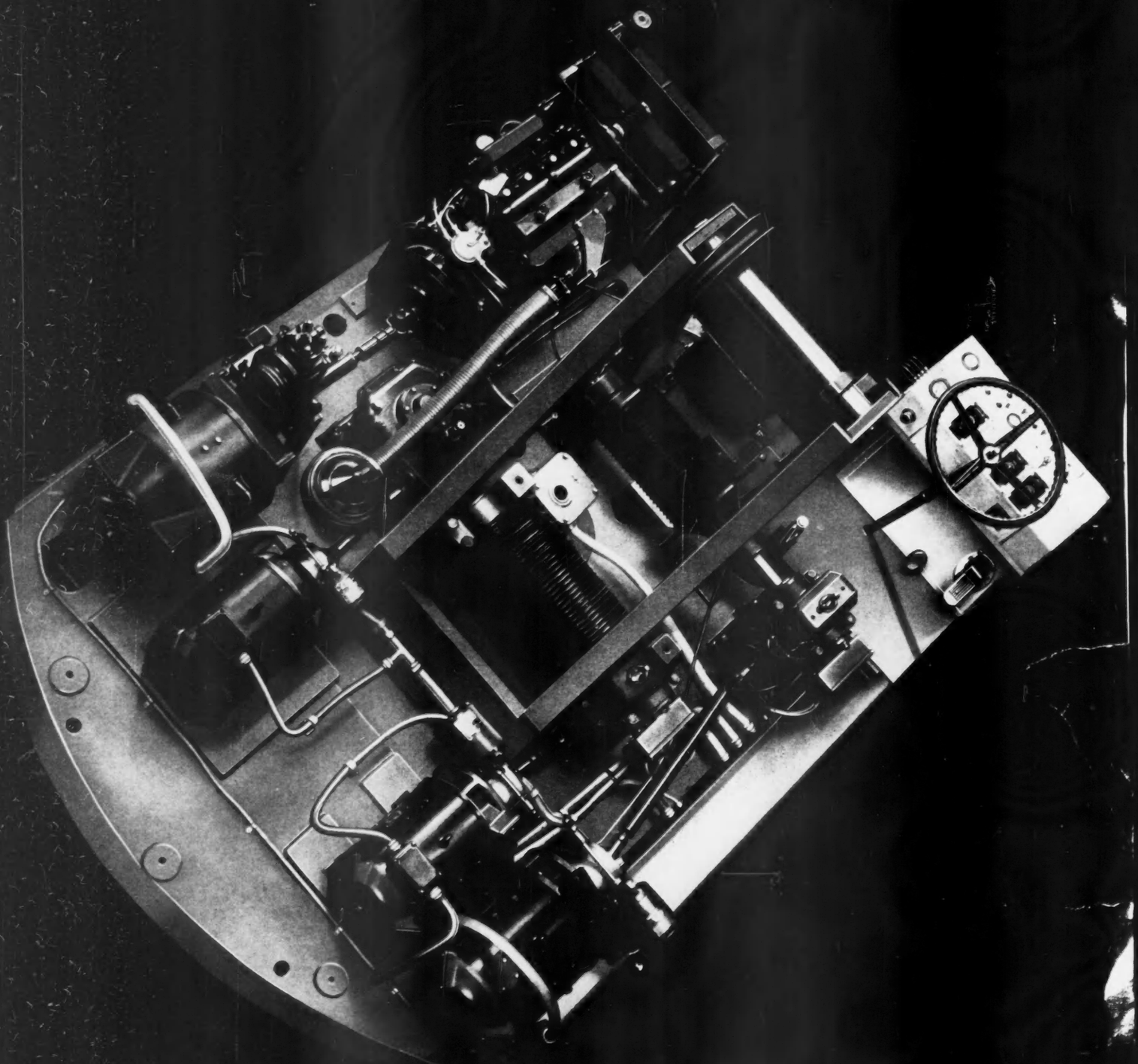
COCKBURNS LIMITED
CARDONALD GLASGOW S.W.1

London Office:
175 Piccadilly W.1

N. E. Depot:
Fish Quay, N. Shields.

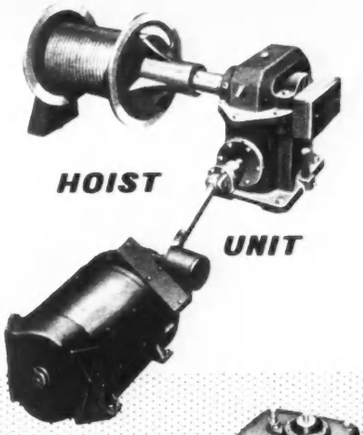
L

COLES *the crane with real* UNIT CONSTRUCTION



the name that carries weight-

a clean simple layout gives you ease of maintenance



The Power for good in industry . . .
Coles Diesel-Electric system, built on UNIT CONSTRUCTION principles, combines the utmost operating efficiency with minimum maintenance. Coles real UNIT CONSTRUCTION is the ultimate in simplicity which is the keynote of the system. Generator and motors give long, trouble-free service and no specialised electrical knowledge is necessary for operation and maintenance. Coles Cranes are designed to stand up to EVERY KNOWN OPERATING ABUSE. Send today for the detailed technical specifications and see how YOU can profit by the use of Coles.

Designed, Manufactured and Marketed by —

STEELS ENGINEERING PRODUCTS LIMITED,
Sunderland, England. SALES & SERVICE: London, Birmingham, Manchester, Newcastle, Glasgow.

in your industry

COLES
CRANES

1,450

more units with ONE SPEEDICUT TAP

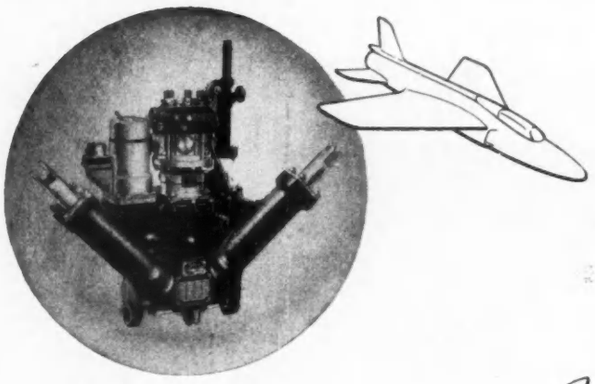
KNOW HOW

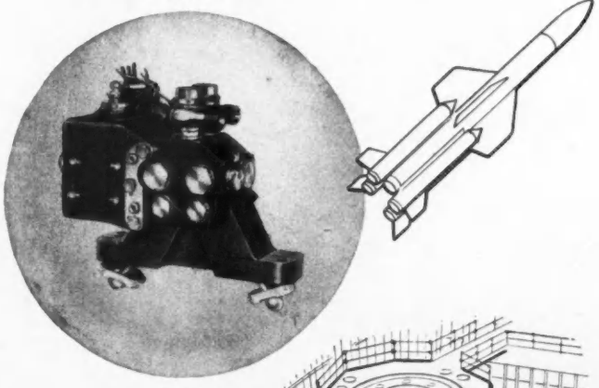
Our customer produces Iron Pipe fittings. Normal tap life when machine tapping was only 40/50 components. A Technical Representative from Speedicut Works studied the problem and made recommendations on design and treatment which increased tap life on this operation to over 1500 components.

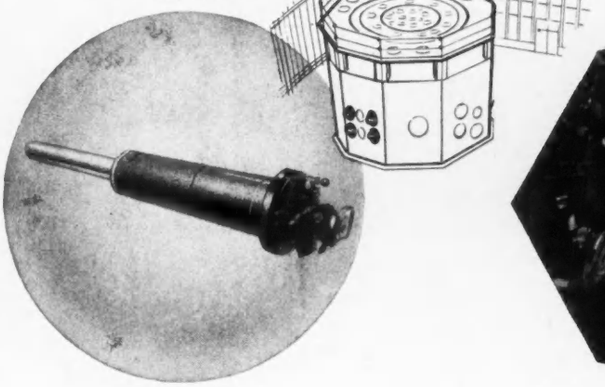
Take advantage of the latest techniques in tool making—SPECIFY SPEEDICUT.

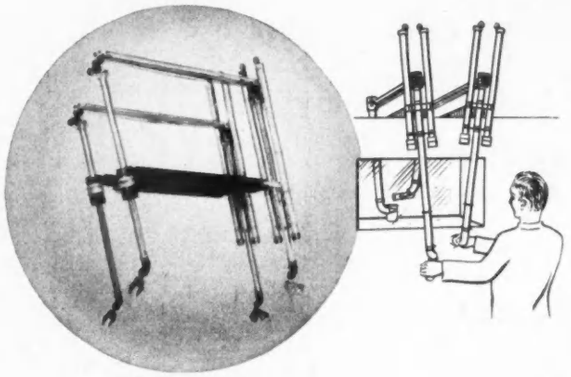
F. B. T. FIRTH BROWN TOOLS LTD.

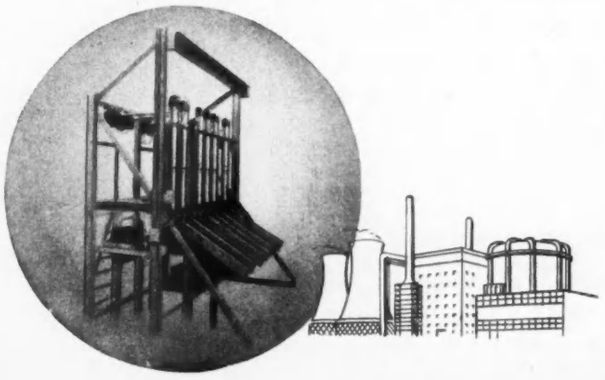
SPEEDICUT WORKS . CARLISLE STREET EAST . SHEFFIELD











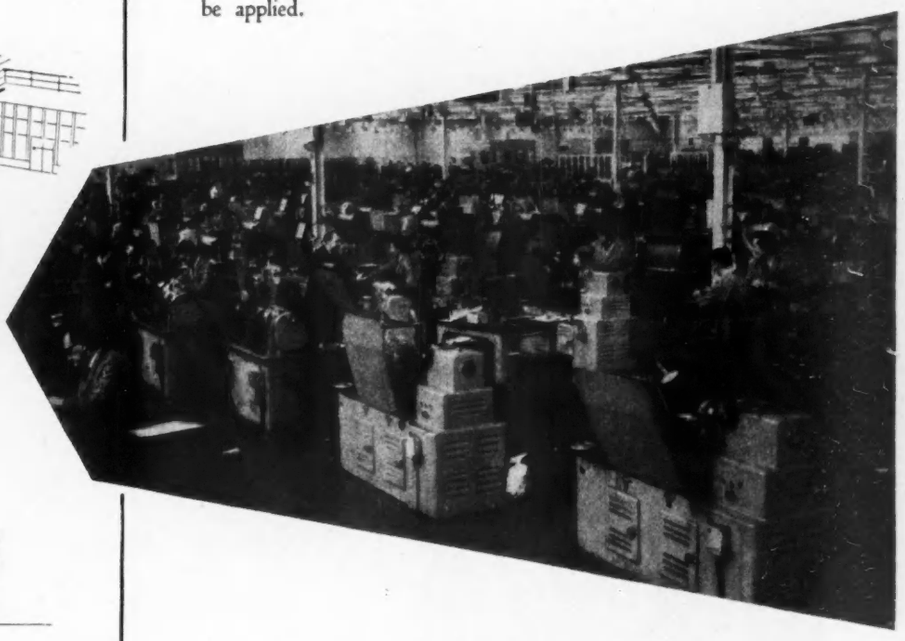
In Many Spheres...

Hobson

Skill and experience in engineering has long been successfully applied in the design, development and manufacture of various specialised components of high precision character.

Present production is concerned mainly with advanced projects relative to the aircraft and nuclear power industries.

We have a technical staff capable of dealing with the many problems of modern engineering technique and invite enquiries regarding projects to which our wide experience can usefully be applied.



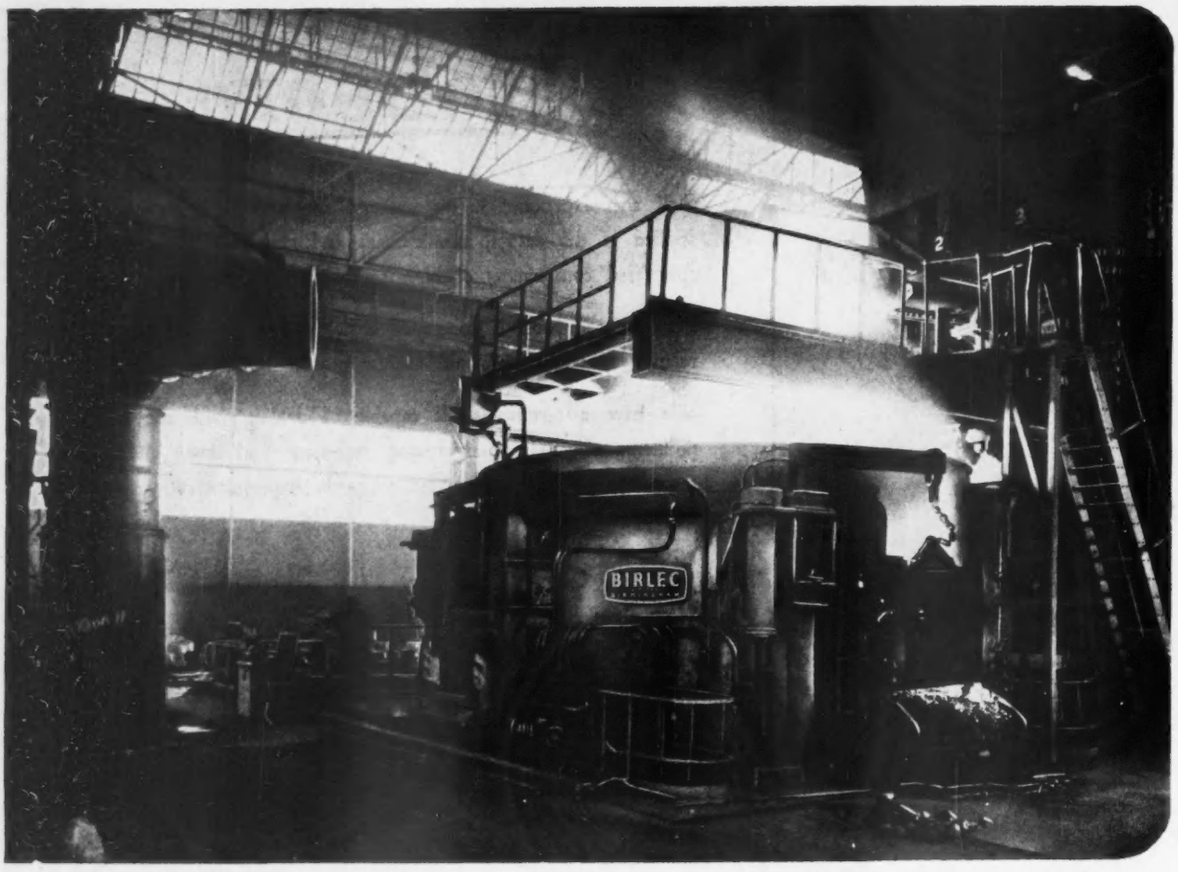
TYPICAL EXAMPLES OF HOBSON PRODUCTS

Hydraulic Jacks and Servos
Electro-Hydraulic Servo Actuators
Hydraulic Pumps and Motors
Liquid Flowmeters
Engine Control Systems
Mercury Manometers
Remote Reading Contents Gauges
Remote Handling Equipment
Honeycomb Isotope Manufacturing Machines
Electro-Mechanical Control Systems for Atomic Reactors
Specialised Gearboxes
Atomic Reactor Ancillary Equipment
Hydraulic Variable Speed Drives

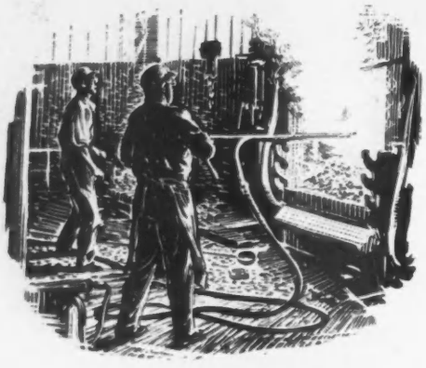
H. M. HOBSON LIMITED
WOLVERHAMPTON ENGLAND

M

Advancement in Steel Production . . .



Electric Arc Furnaces, Round Oak Steel Works



Electric Arc and Siemens Open-hearth Steels—Mild, Carbon, Case-hardening, Free-cutting, Alloy, to all specifications

ROUND OAK STEEL WORKS LIMITED

BRIERLEY HILL · STAFFS

Branch Offices

LONDON
Round Oak Steel Works Ltd.,
The Adelphi
London, W.C.2.
TRAFALGAR 5633

MANCHESTER
R. Tranter Owen,
121/122, Royal Exchange,
Manchester, 2.
BLACKFRIARS 9743/4

SHEFFIELD
J. Cook,
324, Carterknowle Road,
Sheffield, 11.
SHEFFIELD 51104

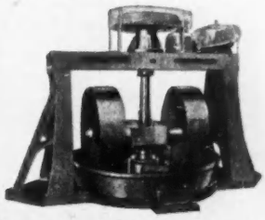
A GKN COMPANY

In these days of AC it is not always easy to get DC motors and generators quickly and at a reasonable price. Fortunately, EPE specialise in DC equipment, bringing years of experience to bear on the subject, so that one can always be sure of DC motors and generators, of any enclosure, at competitive prices, on short delivery. EPE are always happy to help solve DC problems, too.

E·P·E

ELECTRICAL POWER ENGINEERING CO. (B'ham) LTD.
Bromford Lane, Birmingham 8
'Phone: STEchford 2261
'Grams: Torque 'Phone Birmingham
London Office: 421, Grand Buildings, Trafalgar Square, W.C.2. 'Phone: WHitehall 5643 and 7963

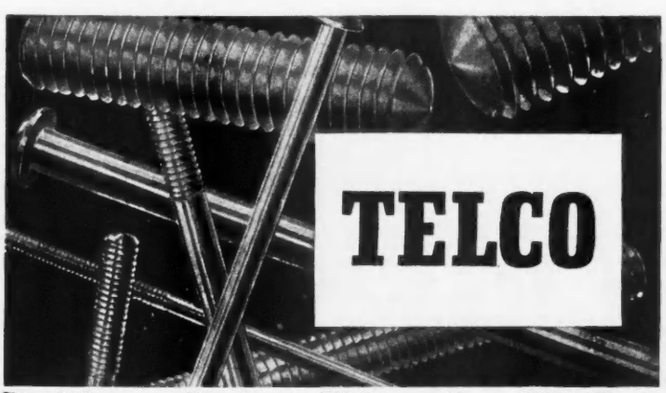
TRADE Smedley MARK
PAN GRINDING MILLS



REVOLVING OR STATIONARY PANS
PERFORATED OR SOLID BOTTOMS
OVER OR UNDER DRIVEN
Smedley Brothers. Ltd.
Belper. Derbyshire.
Telephone: Belper 12

WELDED STEEL PLATEWORK
In ⅛" to ½" thick Mild Steel
PRESSURE VESSELS
TANKS & CYLINDERS
CHIMNEYS
DRYERS
HOPPERS
CYCLONES
BEDPLATES
ANGLE & FLAT BAR RINGS
C&M. ENGINEERING CO. LTD
THAMES Rd. BARKING, ESSEX
TELEPHONE: RIPpleway 3011-2

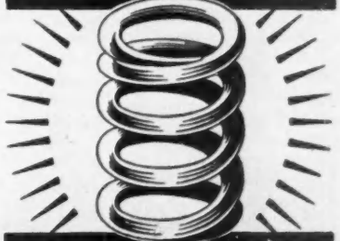
SIRRON
Diesel Engines
Main Propelling Diesel Engines in powers up to
1,200 H.P.
THE NEWBURY DIESEL CO. LTD.
NEWBURY, BERKS



Studding · Studs · Allthreads · Tie Rods
TELCO LTD., 3 Newman Street, London, W.1 MUSeum 5701/4

Increase production! by using
SCRIVEN MACHINE TOOLS
CROSTHWAITE FURNACES and SCRIVEN MACHINE TOOLS LTD.
York Street Ironworks, Leeds 9 Tel.: 32411-2
32, Victoria Street, London, S.W.1 Tel.: Abbey 2966

SPRINGS AND SPRING WASHERS
FOR ENGINEERING PURPOSES

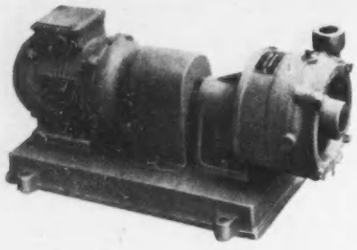


Manufactured by
JOHN TONKS & CO LTD.
CENTRAL SPRING WORKS
Furnace Hill, SHEFFIELD, 3
Telephone SHEFFIELD 24679 Telegrams TONKS SHEFFIELD 3

—the most versatile small pumps ever!

The unique design of the Girdlestone 'Seal' range of centrifugal pumps enables them to be mounted and driven in many different ways, and their exclusive mechanical shaft seal arrangement makes them suitable for all water duties and for handling a wide range of solvents and corrosive liquids.

'Seal' CENTRIFUGAL PUMPS



Available in five sizes from ¾" to 1½", with same shaft and flange dimensions for interchangeability of mounting. Constructed of cast iron, bronze or stainless steel. Illustrations show the pump fitted as a Motorpump Unit and as a Direct-coupled set.

Girdlestone of course!

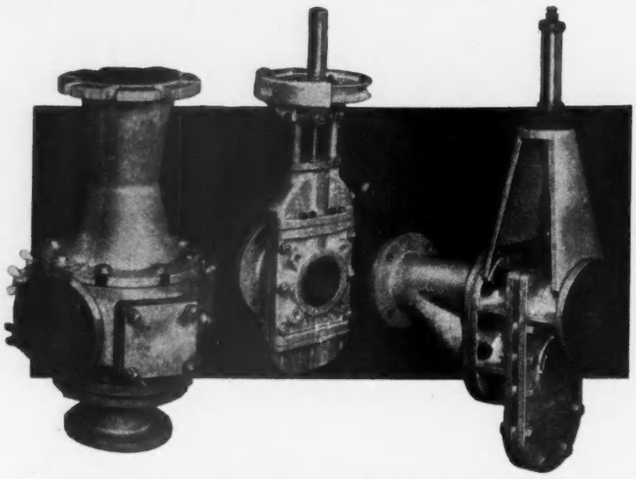
For fully informative leaflet, write to .

GIRDLESTONE PUMPS LTD.

23 Davies Street, London, W.1. *Telephone: Mayfair 1354 & 5317*

T.116

Intricate Castings -are our Business!



We specialise in intricate castings of all types and pride ourselves on the very high standard of precision we attain. Small quantities of this type of work are acceptable, and the more intricate—the better.

We are always ready to assist clients' technicians in the solving of the most intricate casting problems, and welcome their co-operation on our factory floor.

When next you have a tricky casting job, consult us—you will find our friendly help and advice of great value.

SAMUEL JELLYMAN LTD

CANNOCK FOUNDRY & ENGINEERING WORKS

CANNOCK · STAFFS

TELEPHONE— TELEGRAMS CANNOCK 2188

HEAVY DUTY SPANNERS

Precision Hand Tools are of paramount importance to the Engineering Industry. King Dick hand tools are precision made under carefully controlled conditions, and set a superlative standard in quality and design. From the largest Constructional Engineering Tools to the smallest B.A. Socket Set, King Dick inspection routines ensure the correct combination of selected steels, perfect balance and precision.

Send for illustrated catalogue giving complete range of King Dick Hand Tools.

BINGDON

KING DICK

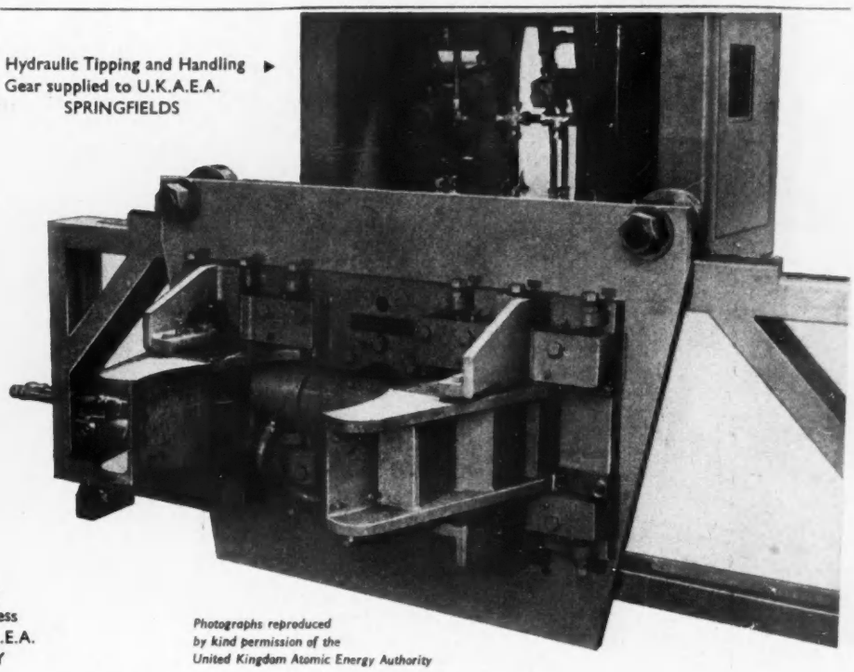
PRECISION **HAND TOOLS**

ABINGDON KING DICK LTD., ABINGDON WORKS, TYSELEY, BIRMINGHAM 11, ENGLAND

R.E. 216

SPECIAL PURPOSE EQUIPMENT SUPPLIED TO U.K.A.E.A.

50 tons Hydraulic Double Acting Press supplied to U.K.A.E.A. DOUNREAY



Hydraulic Tipping and Handling Gear supplied to U.K.A.E.A. SPRINGFIELDS

Photographs reproduced by kind permission of the United Kingdom Atomic Energy Authority

We will be pleased to quote for any Special Purpose Machinery

ENTWISLE & GASS LTD.

ASSOCIATED WITH THE PLANTERS ENGINEERING CO., LTD., LONDON

NELSON STREET, BOLTON *Telephone: No. 5967/8*

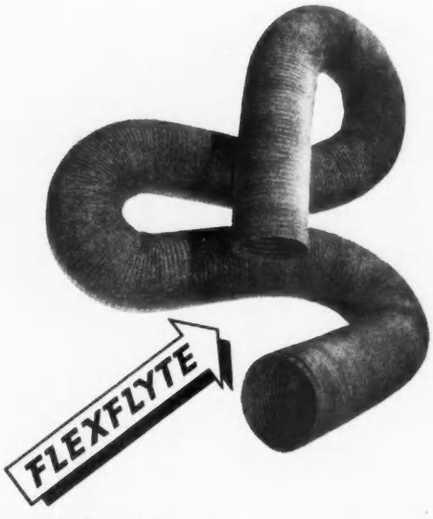
Established 1852

Whatever your DUCTING *problems . . .*

FLEXIBLE

will do the job better

Designers, Engineers, Architects and Surveyors all agree that SPIRATUBE and FLEXFLYTE are the most versatile, economical, ideal flexible ductings now available for industrial, marine, aircraft, mining and tunnelling ventilation, and air conditioning installations. Each specifically designed to do their own job, Spiratube and Flexflyte are available in diameters from ½" to 30" and can handle conditions in a range of temperature from minus 120°f to 600°f. The unique construction of Spiratube and Flexflyte offers minimum bend radii, a resistance to oils, greases, many solvents, acid and alkaline fumes, and flame and temperature extremes. Technical data and brochures available.



(½" - 8") diameters. The ideal flexible ducting where lightness, strength, resistance to pressure and a wide range of temperatures is an operating necessity.

(3" - 30") diameters. Light, tough, flexible, retractable with low installation costs. Easy to dismantle and store ready for re-use.

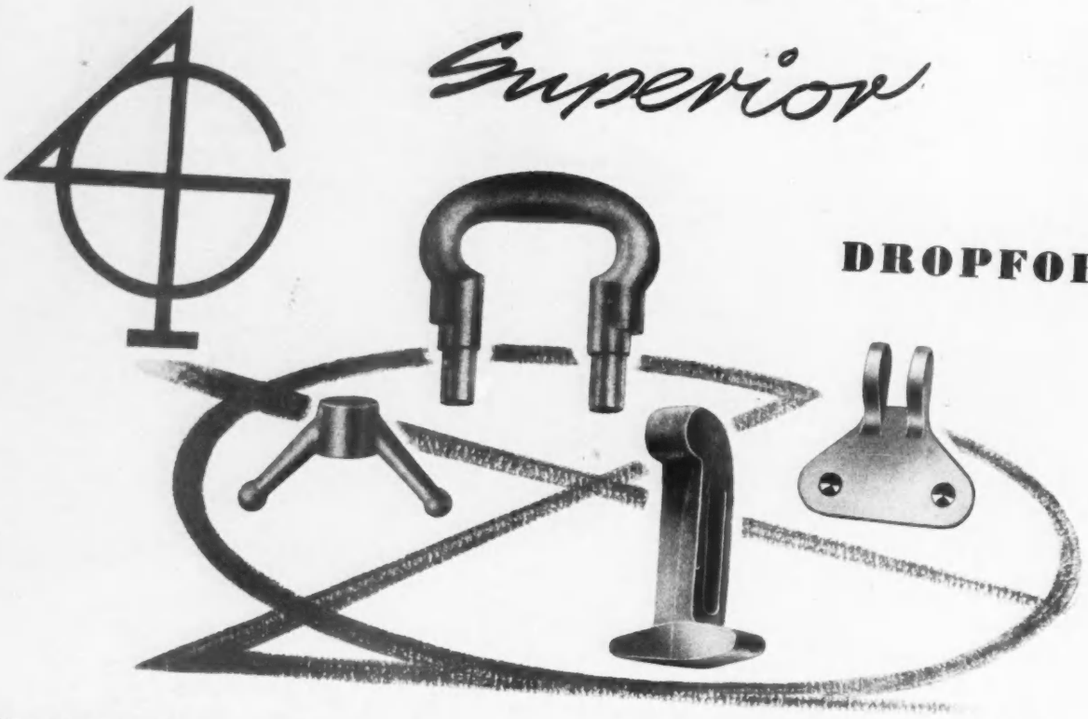
FLEXIBLE DUCTING LTD.

SHUNA STREET, MARYHILL, GLASGOW, N.W.

Telephone: MARyhill 3311 *Telegrams:* FLEXIDUCT, GLASGOW N.W.

THE SYMBOL OF . . .

Superior



DROPFORGINGS

THE BLACKHEATH STAMPING CO. LTD. BLACKHEATH · BIRMINGHAM

Have you done anything about this !!!

...t one man can load with a PARKER PORTABLE BELT LOADER and POWER-SCOOP

Put a Power-scoop to work with a Parker Portable Belt Loader and speed up bulk handling, cut labour costs to the minimum. With the Power-scoop one man can feed the loader to capacity, load 3 tons of coal in 7 minutes! For shifting and loading bulk materials with maximum efficiency at minimum cost, investigate the possibilities of the Power-scoop. It is available for fitting to the Parker Loader or as an independent outfit.

THE PARKER POWER-SCOOP has a 300 lb. capacity steel scoop drawn by an electrically operated winch controlled by a thumb button on the scoop handle. 75 ft. of steel wire rope gives a working radius of 60 ft. Self-powered, independent outfits are now available for use with any machine or for general bulk material moving.

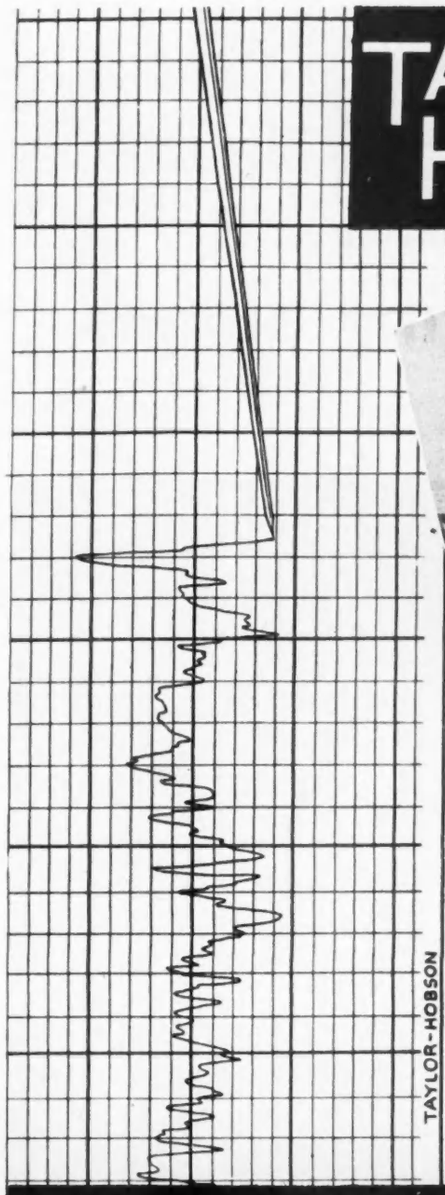
PARKER PORTABLE BELT LOADERS are available with boom lengths of 20 ft. and 30 ft. Discharge heights 8 ft. 3 in. or 12 ft. 3 in. Belt widths 16 in. or 20 in. Extras include barge boards, cleated belt, swivelling wheels and float hopper.

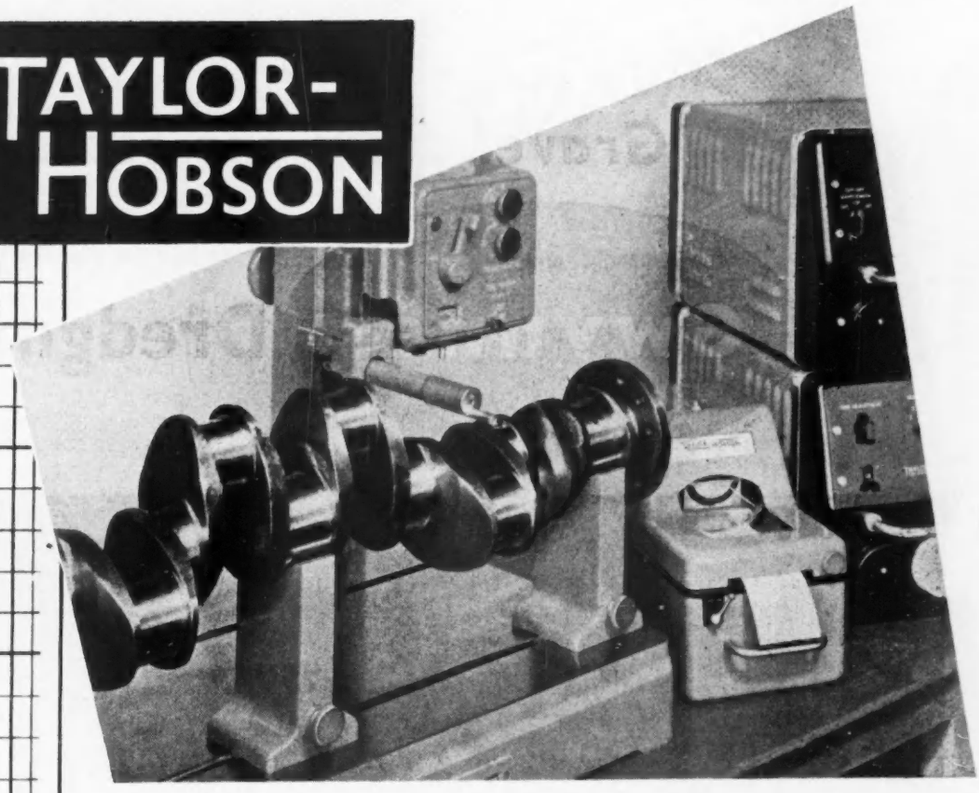
FREDERICK PARKER LIMITED

VIADUCT WORKS LEICESTER
PHONES LEICESTER 62531 (7 LINES)
LONDON STAFFORD HOUSE, NORFOLK STREET, W.C.2
Depots at London, Cardiff, Sedgley (Staffs.) and Leeds.

reminder!

TAYLOR-HOBSON





for measuring the surface texture and flatness of all moving parts in the following industries:

'TALYSURF'

BALL AND ROLLER RACE
AUTOMOBILE
MACHINE TOOLS
GAS TURBINES
GYROSCOPES
FUEL PROJECTORS
PUMPS
MISSILES
RESEARCH INSTITUTES

TAYLOR - HOBSON PRODUCTS INCLUDE

'Talysurf' Surface Measuring Instruments
'Talyrond' Roundness Measuring Instruments
'Micro' Alignment Telescope
Cold Rolling Mill Gauges
Profile Projectors
'Talymin' Gauges and Comparators
Type 'B' Autocollimator
Turbine Blade Edge Microscopes and Projectors
'Talymin' Bore Comparators
'Talyden' Workshop Microscopes

Engraving, Routing, Milling and Diesinking Machines

A Division of RANK PRECISION INDUSTRIES LTD.

TAYLOR, TAYLOR & HOBSON, LEICESTER, England

TS49

Gravel from the sea bed—

Gwynnes Dredging pumps

Photograph by Skyfotos Ltd.

The M.V. "*Sand Skipper*" of the South Coast Shipping Company is fitted with a 14" Gwynne Dredging Pump which delivers over 200 tons of material per hour into the hopper from a depth of 60 ft. below water level.

GWYNNES PUMPS LTD
HAMMERSMITH · LONDON W.6
Telephone: RIVerside 3682 (4 lines)
Telegrams: Gwynne · Hammer · London

GWYNNES PUMPS

Centrifugal, Mixed flow, Axial flow,
Single and Multi-stage, Vertical and Horizontal
Spindle pumps for all purposes

HERCULES HOSE FITTINGS save you a 'pretty penny'!

★ **REDUCE REPLACEMENT COSTS**
—give old hose a new life.

★ **ELIMINATE PRESSURE LOSSES**
—leaky hose means reduced efficiency.

★ **SIMPLE TO APPLY**
—no clips, clamps or wires needed.

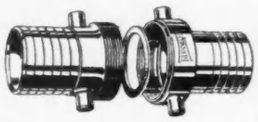
★ **EASY TO FIX**
—no special tools. Only a hammer to fix the Claw Grips.

★ **SAFETY IN USE**
—no projections to work loose or obstruct.

NEW lug-type Couplings for suction and delivery hose, in brass, gunmetal or stainless steel.

Hercules Repairers, Screw Couplings, Adaptors, etc., for pneumatic, oxy-acetylene and all industrial hose.

HERCULES
SIMPLY HAMMER IT

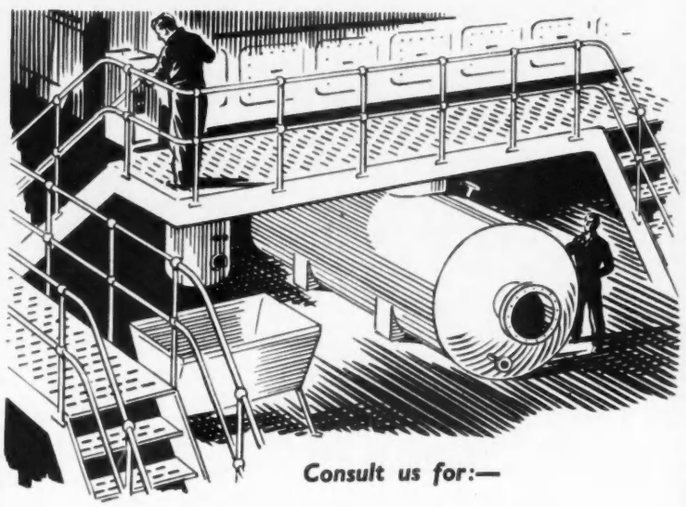


Full information and prices from:

NEWTON SALES COMPANY LTD

(Industrial Division) 517, FULHAM ROAD, LONDON, S.W.6. Tel.: FULham 4228.

THE SPECIALISTS IN HOSE FITTINGS



Consult us for:—

OPEN STEEL FLOORING
TUBULAR HAND RAILING & STANDARDS
STEEL PLATFORMS & STAIRCASES
TANK WORK
PRESSED STEEL GUTTERS
GENERAL PLATE WORK & FABRICATIONS

E. HAYWARD & CO. (Fabrications) LTD.

POUNTNEY STREET · WOLVERHAMPTON

Telephone No.: Wolverhampton 23300

Forgings

GEORGE MILLS (ENGINEERS) LTD. Established 1920

IN IRON & STEEL UP TO 1½ CWTS.

214-218 RAVENSCROFT RD., BECKENHAM, KENT Telephone: SYDenham 5235

A.I.D. APPROVED

A.R.B. APPROVED

PROTOTYPES AND SPECIAL PURPOSE MACHINES

HEAVY AND "AWKWARD" MACHINING & GRINDING

REPAIRS & SALVAGE BY METAL DEPOSITION IN STELLITE, CHROME, NICKEL Etc.

WELDING FABRICATING PROFILE FLAME CUTTING AND GENERAL PRESSWORK

DON'T LET SOLDERING MAKE YOU FEEL SMALL

use FLUXITE

Soldering ceases to be a knotty problem the moment you use FLUXITE. Solder flows on easily and smoothly—and stays on. For over half a century FLUXITE has been the choice of craftsman and engineer alike and, in this age, its reliability and speed has made FLUXITE even more in demand than ever.

FLUXITE Ltd., Bermondsey St., London, S.E.1

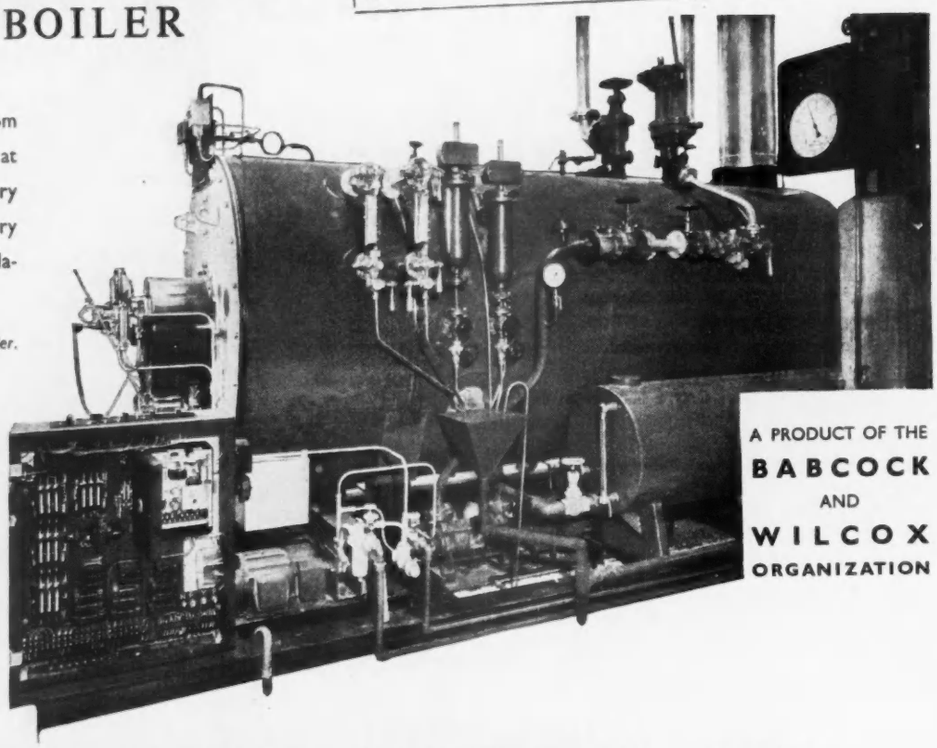
GM 80

"THE STEAMBLOC"
PACKAGED BOILER

Fully Automatic—Oil Fired
High Efficiency Boiler Plant
GUARANTEED 82.5% EFFICIENCY

The Steambloc is designed in a range from 1,500 to 18,000 lb. steam per hour (from and at 212°F). Its special three-pass design enables very high efficiencies to be obtained under ordinary commercial operating conditions. On many installations it exceeds 85%.

Send for Publication No. 1628/3—The Steambloc Packaged Boiler.

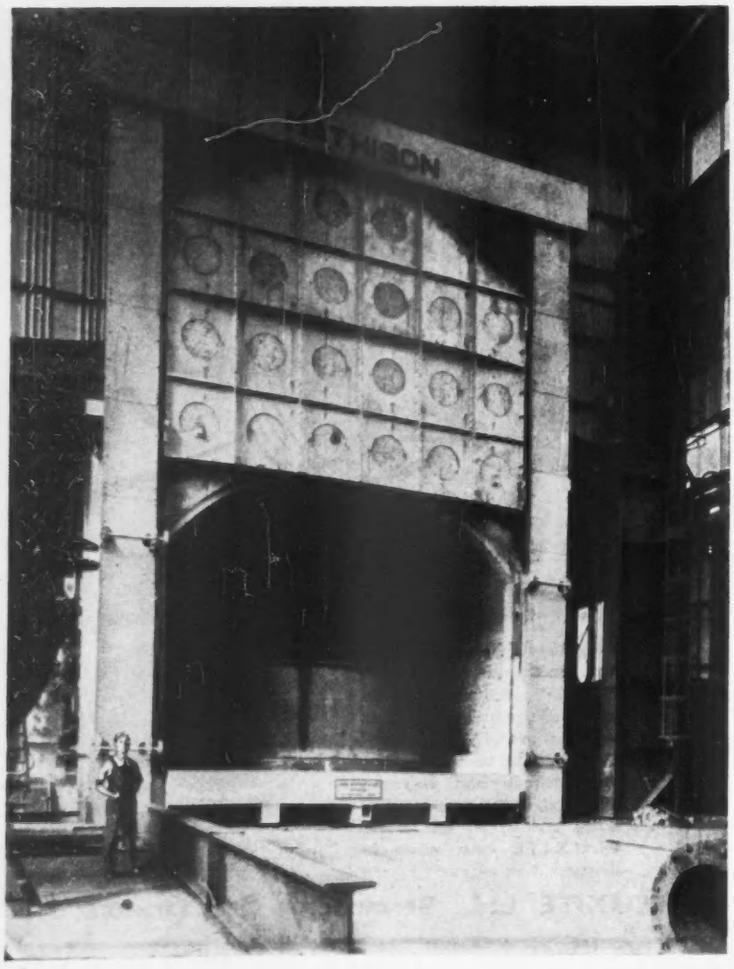


A PRODUCT OF THE
BABCOCK
AND
WILCOX
ORGANIZATION

Lower steam requirements are met by the CLARKSON Packaged Vertical Boiler of Thimble Tube Design. Range 250 lb. up to 3000 lb. steam per hr. Max. W.P. 120—Clarkson Thimble Tube Boilers. Send for Publication No. 702.

SPENCER - BONECOURT - CLARKSON LTD.

28 Easton Street, London, W.C.1. Telephone: Terminus 7466



MATHISON

STRESS RELIEVING FURNACES "MATHISON" VERTICAL FLAME RECIRCULATING TYPE

Town gas fired.

Load : 60 tons.

Fuel Consumption : Under 4,500 cu. ft. per ton.

Temperature Range : 200°-900° C.

Electrically Operated Bogie Haulage Gear : To move maximum load of 150 tons.

Temperature Uniformity on 4-zone Control : plus or minus 5° C.

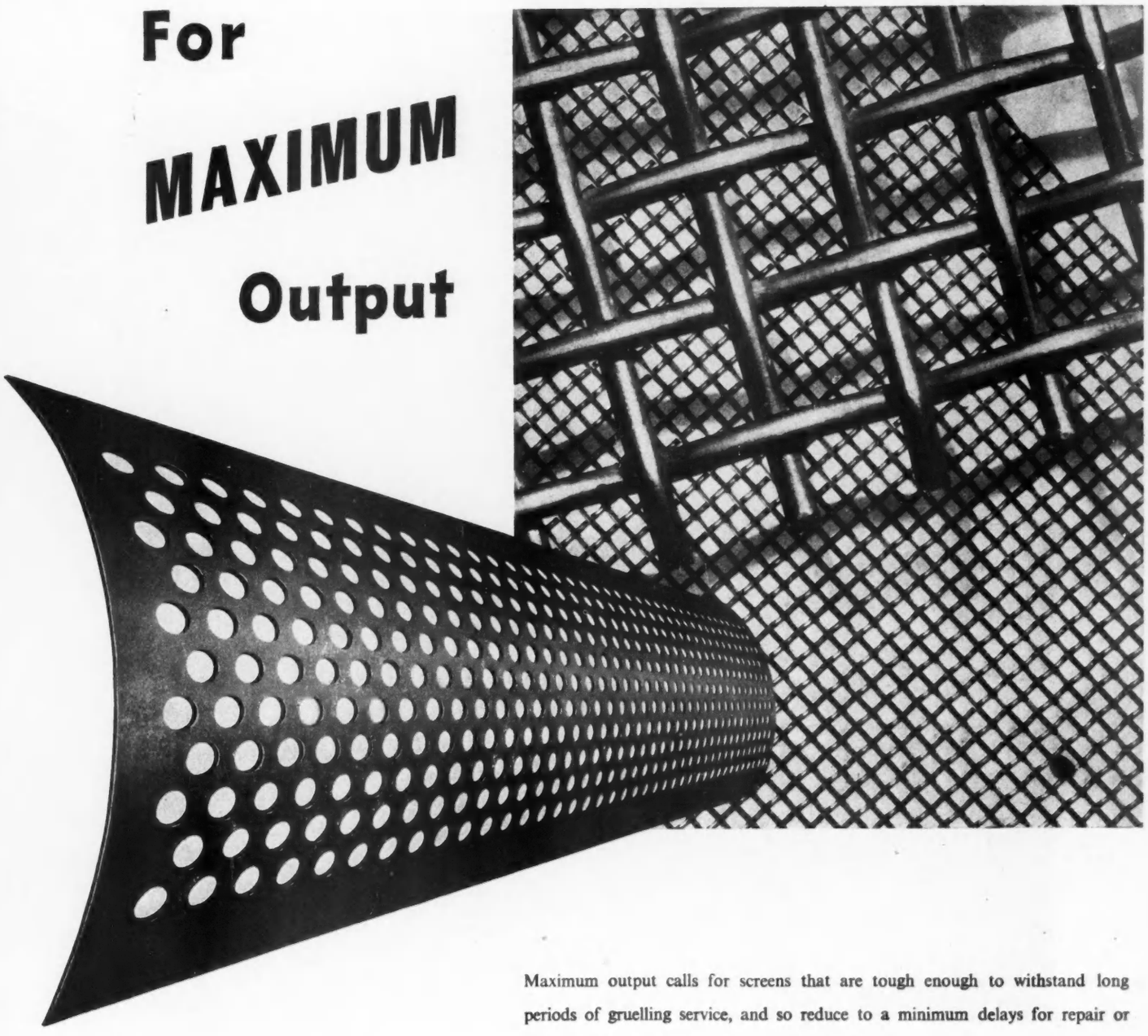
Internal Dimensions of Furnace illustrated : 27′ 2″ long × 25′ 6″ wide × 21′ 0″ to the centre of the arch.

Scale totally eliminated.

"Our latest installation, in the most modern Heavy Plate Fabricating Shop at Messrs. Head Wrightson Teesdale Limited, Thornaby-on-Tees. Designed and built, and put into commission by . . . . . .

JOHN MATHISON LTD,
Engineers,
HUTTON HALL · GUISBOROUGH
North Yorks, England

For MAXIMUM Output



Maximum output calls for screens that are tough enough to withstand long periods of gruelling service, and so reduce to a minimum delays for repair or replacement. In fact, maximum output calls for

'HARCO' PERFORATED METAL AND WIREWORK SCREENS

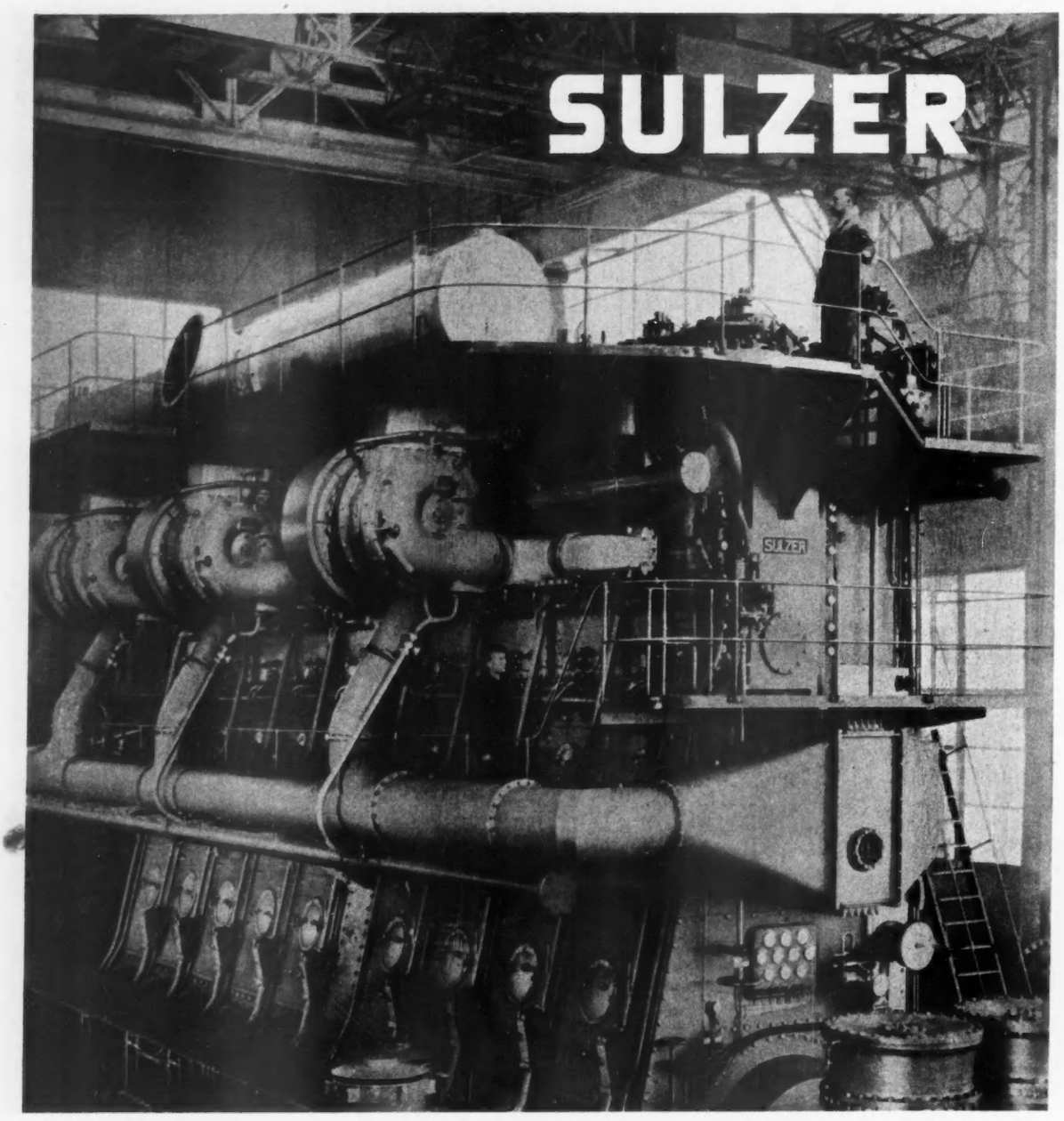
Please ask for Catalogues Nos. E858 and E926

Supplied as flat or curved plates, or as complete screens to specification, in a wide range of gauge, mesh and pattern for every screening, sorting or sizing requirement.

Harvey

G. A. HARVEY & CO. (LONDON) LTD.
Woolwich Road, London, S.E.7. GREenwich 3232 (22 lines).

P/W/1



TWO-STROKE MARINE ENGINES OUTPUTS UP TO 24,000 H.P.

TURBO-CHARGED MARINE ENGINES

SULZER BROS. (LONDON) LTD.

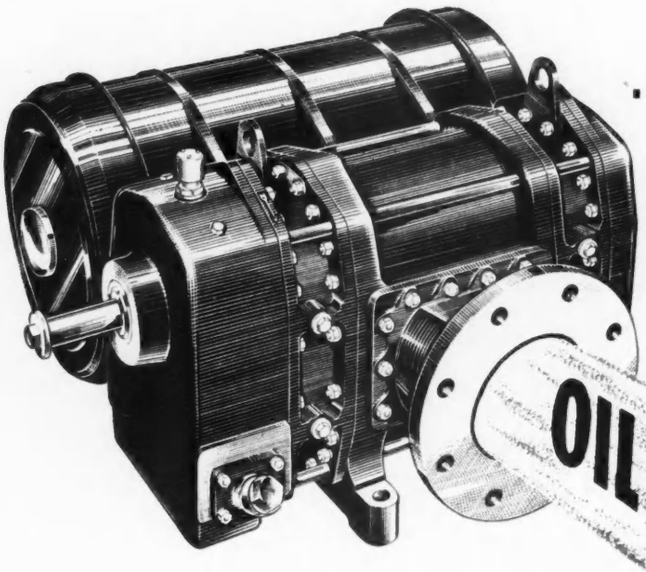
31, Bedford Square, London, W.C. 1.

Telephone : MUSeum 7890

Sulzer Licensees in Great Britain :—

Barclay, Curle & Co., Ltd.
John Brown & Co. (Clydebank), Ltd.
Cammell Laird & Co. (Shipbuilders & Engineers), Ltd.
*George Clark & North Eastern Marine (Sunderland), Ltd.
William Denny & Brothers Ltd.
Fairfield Shipbuilding & Engineering Co., Ltd.
Hawthorn Leslie (Engineers), Ltd.
Alexander Stephen & Sons, Ltd.
Vickers-Armstrongs (Engineers), Limited.
Wallsend Slipway & Engineering Co., Ltd.
David Rowan & Co., Ltd.

M16



. . . for pneumatic conveying

where large flows of oil-free air are required at moderate pressures — specify **GODFREY INDUSTRIAL BLOWERS.** Units are available to suit static and mobile installations.
Performance : air flows up to 3,400 c.f.m. at pressures up to 15 p.s.i. (max.) according to type.
The model L-675 illustrated is especially suitable for use in bulk transport vehicles ; it is compact and light in weight. Low costs at overhaul are assured by the simple design ; air flow 520 c.f.m. at 15 p.s.i. (max.)

OIL FREE AIR

See our exhibits on Stand No. 13 inner row Gallery, Grand Hall, ENGINEERING, MARINE EXHIBITION.

Write for further particulars

SIR GEORGE GODFREY & PARTNERS (INDUSTRIAL) LIMITED

HANWORTH, MIDDLESEX TELEPHONE: FELTHAM 3291 CABLES: GODFREPART, LONDON

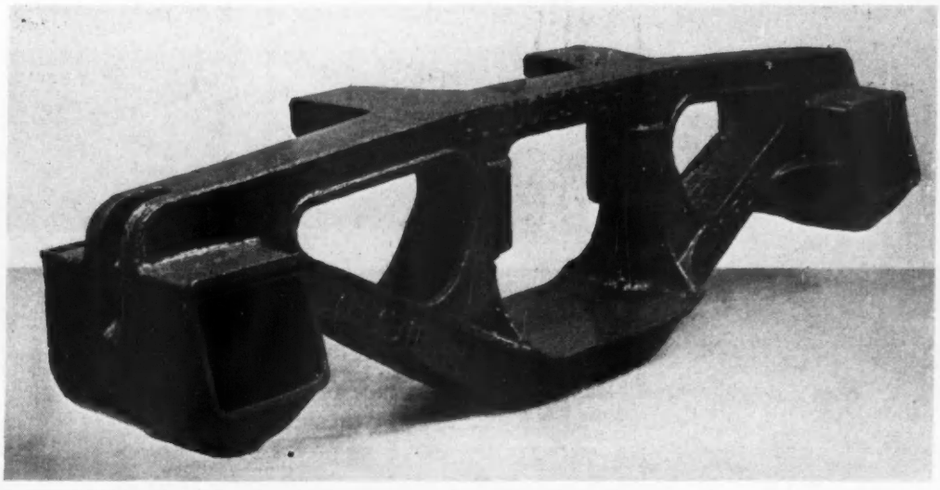
GODFREY
SIR GEORGE GODFREY & PARTNERS (IND) LTD.

ASSOCIATED COMPANIES: MONTREAL, MELBOURNE AND JOHANNESBURG

CAST STEEL
BOGIE SIDE FRAMES

. . . part of the Bogie Assembly produced for the Gloucester Railway Carriage & Wagon Company Ltd., and widely used Overseas on the Nigerian, Ghana, Ceylon, Sudan and Argentine Railways.

A typical example of the high quality castings regularly supplied for GENERAL ENGINEERING, WAGONS, LOCOMOTIVES (Steam and Diesel), COMMERCIAL VEHICLES, COLLIERY PLANT and ELECTRICAL MACHINERY.



R H

ROBERT HYDE CASTINGS

NORTH STAFFORD STEEL FOUNDRY
STOKE-ON-TRENT · *Tel : 44261-2*
CLARENDON WORKS · **CHESTERFIELD** *Tel : 3181-2*
LONDON OFFICE :
52, GROSVENOR GARDENS, S.W.1.
Tel · SLOANE 9972

STEEL CASTINGS

From ½ lb. to 15 cwts.

BREAKDOWN and SHIP REPAIR
WORK GIVEN SPECIAL ATTENTION

STEEL CASTINGS of all descriptions made in our own foundry by CONVERTER & HIGH FREQUENCY INDUCTION PROCESSES

BARNARD & SONS, LTD.
75 River Road, Barking, Essex
Rippleway 1188-9

Consult
FILTON
For Rotary Unions—

Patented

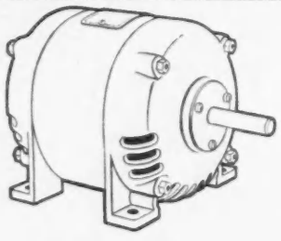
For use on all types of Rotary and Semi-Rotary machines for Leakproof Fluid Transfer.
Standard Sizes ¼" — 3" B.S.P.
Special Sizes & Designs up to 6" B.S.P.
(TYPICAL EXAMPLE SHEWN ABOVE)

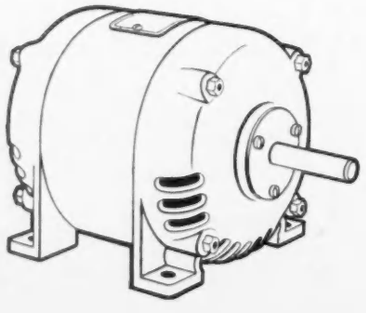
As used by leading Engineering Companies and Government Departments

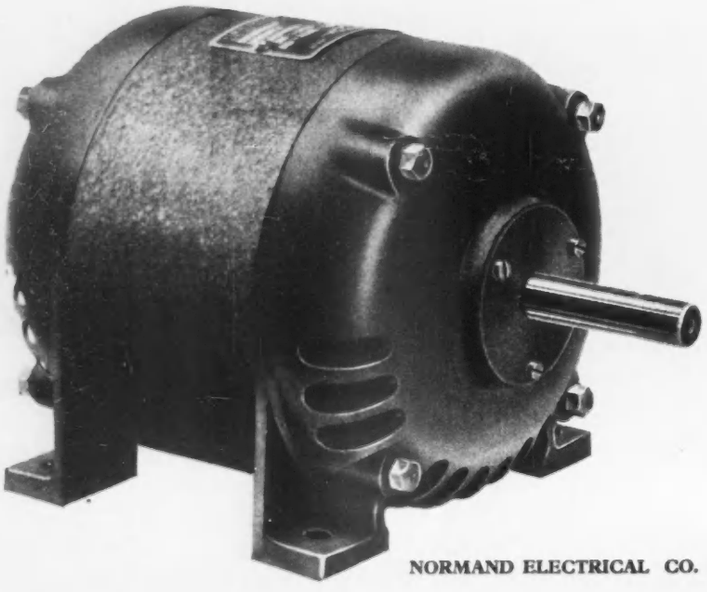
FILTON LIMITED,
CLAPHAM STREET, LEAMINGTON SPA, WARWICKSHIRE
Telephone: LEAMINGTON SPA 8111/2

electric motors

NECO electric motors, from ⅛ H.P. to 5 H.P., provide the finest range of small-output power equipment, running at speeds of 700 r.p.m. and upwards. All types, enclosures and voltages, with foot or flange mountings, are supplied to your own specification.







NECO TRADE MARK

for all industrial purposes

NORMAND ELECTRICAL CO. LTD. · NORTH STREET · LONDON · SW4 MACaulay 3211/4

Oil-Free Compressed Air!

"BROOMWADE" Dry-cylinder, Carbon-ring Air Compressors have been designed to meet the requirements of those industries where OIL-FREE air is essential. The air delivered by these "BROOMWADE" Compressors is ENTIRELY FREE FROM OIL. They have been proved to be ECONOMICAL, EFFICIENT AND RELIABLE in operation both at home and overseas.

ENGINEERING MARINE WELDING & NUCLEAR ENERGY EXHIBITION
Stand No. 8, Row H
Grand Hall.
Olympia.
April 16th–30th, 1959.

"BROOMWADE"

AIR COMPRESSORS & PNEUMATIC TOOLS

Your Best Investment

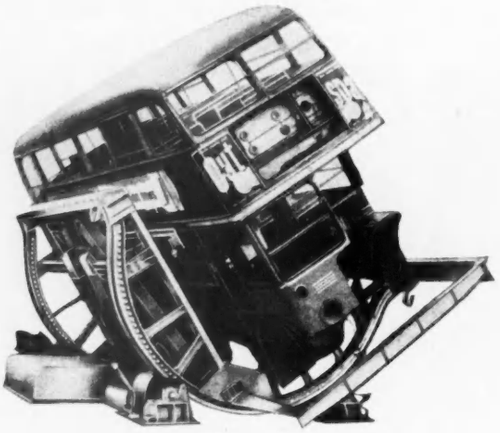
BROOM & WADE LTD., P.O. BOX No. 7, HIGH WYCOMBE, ENGLAND. Telephone: High Wycombe 1630 (10 lines) Telegrams: "Broom", High Wycombe. (Telex)

648 SAS

However specialised the problem—

KING CAN COPE

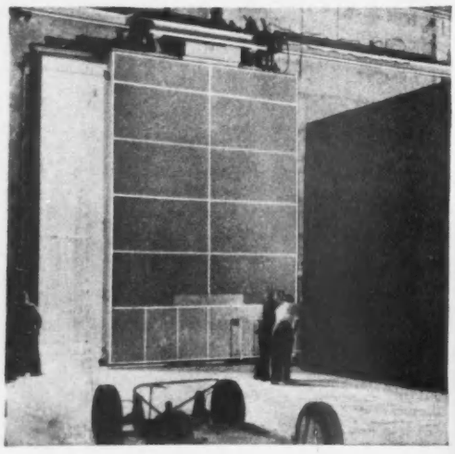
KING overhead runways, pulley blocks and conveyors in the factory—these are everyday requirements. But KING also make specialised equipment. Soundproof doors, flameproof hoists, bus tippers . . . not to mention pneumatic handling equipment, swarf conveyors and even hoists for television lighting.



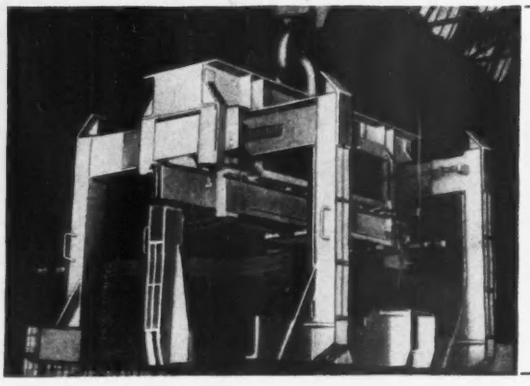
KING INVERTORS Ten KING Invertors like the one above, speed the overhaul of London Transport buses at their Aldenham Road factory.

KING WINDOW CLEANING EQUIPMENT Designed to make light work of all big window cleaning jobs, KING equipment is simple to install on any building. One method is illustrated here.

KING FLAMEPROOF HOISTS The extensive range of KING hoists includes this flameproof model in phosphor-bronze which eliminates the danger of igniting inflammable substances.



KING POWER-OPERATED SLIDING DOORS For sound insulation and other special requirements, KING have successfully evolved special 'Lift and Slide' door gear. A hand-operated sealing device is also available for smaller openings.



KING MANSAVER GRABS Big cost and time saving in industry is provided by KING Mansaver Grabs. Automatic, semi-automatic or manually operated . . . for any weights between 1 lb. and 30 tons.

✻ We shall be pleased to send you any details you require. Our representative will call on you, anywhere in the world.

KING

REGISTERED TRADE MARK

equipment is the best there is

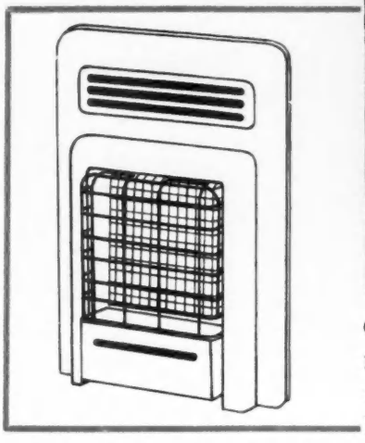
GEO. W. KING LIMITED, 8 ARGYLE WORKS, STEVENAGE, HERTS. TEL: STEVENAGE 440

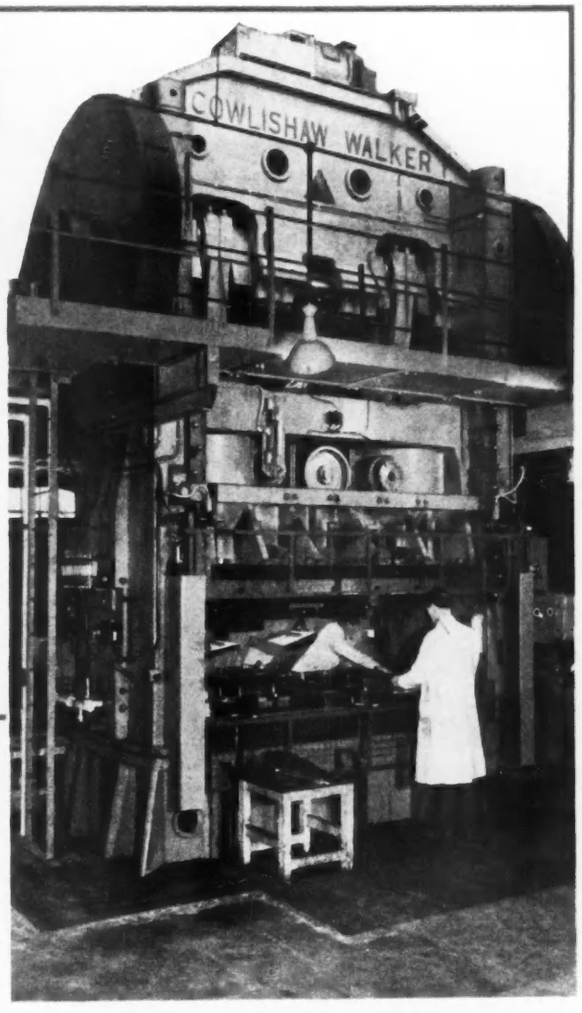
COWLISHAW WALKER

400 TON PRESS

Producing outer casings for the famous range of Bratt Colbran gas fires at their Wembley works.

This advanced and highly efficient design of gas fire sends convected warm air to every corner of the room in addition to the normal radiant heat.





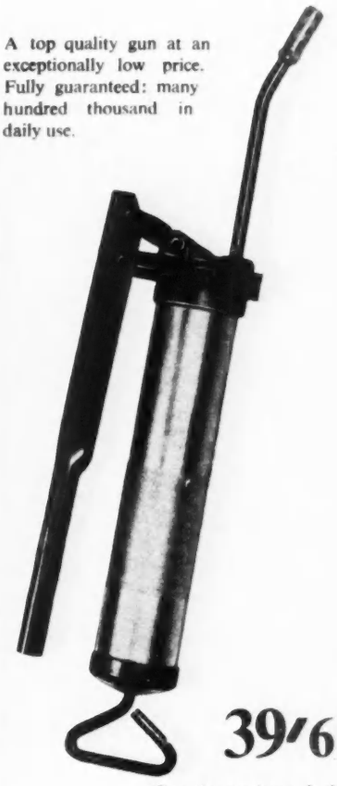
COWLISHAW WALKER PRESSES with their fine craftsmanship and inbuilt dependability have that extra frame and slide rigidity which guarantees better pressings and longer tool life.

COWLISHAW, WALKER & CO. LIMITED

Biddulph, Stoke-on-Trent Telephone: Biddulph 3254 Telegrams: Cowlishaw, Stoke-on-Trent
London Office: 117 Victoria Street, Westminster, London, S.W.1. Telephone: VICtoria 5472

SWEMATIC HIGH PRESSURE GREASE GUN

A top quality gun at an exceptionally low price. Fully guaranteed: many hundred thousand in daily use.



39/6

Complete with cranked extension pipe and hydraulic chuck, as illustrated.

★ The ideal gun for garage and workshop use. ★ Easy operation of the side lever gives pressures exceeding 6,000 lb. p.s.i. ★ For oil (SAE 90 or heavier) and all grades grease. ★ 16 oz. capacity. ★ Suction loading. ★ Valve to release airlocks. ★ All parts replaceable. ★ Black oxide and nickel finish. ★ Special terms for quantities.

OVERHEAD · TRAVELLERS · ELECTRIC GOLIATH

LOCOSTEAM

EST 1899

MARSHALL FLEMING CRANES

OVER HEAD

DELLBURN WORKS MOTHERWELL · SCOTLAND
Telephone: Motherwell 50 Telegrams: "Dellburn" Motherwell

LOCO STEAM ELECTRIC GOLIATH · TRAVELLER

ABBOTT & CO.
(NEWARK) LTD.
Newark Boiler Works
NEWARK · NOTTS
Telegrams: ABBOT NEWARK 34
Telephone: NEWARK 34

BOILERS and AIR RECEIVERS

See Display Advertisement April 10

HYDRAULIC GREASE NIPPLES

Made to British Standards and interchangeable with other makes. Available in bulk or in handy assortments of all popular sizes. Very keen prices.

LAWRENCE EDWARDS & CO.
(Engineers) LIMITED
KIDDERMINSTER, WORCS.

Photograph by courtesy of Rhodesian Railways

THE FIRST ONE
on the last lap

The first 60,000 kVA 330/33 kV 3-phase double wound transformer en route from Lourenco Marques to Salisbury Sub-Station, for the Kariba Hydro-Electric Scheme.

This forms part of the contract awarded to Ferranti Ltd. by the Federal Power Board, Rhodesia and Nyasaland, comprising two 120,000 kVA 330/234 kV 3-phase auto transformers with series boosters, nine 60,000 kVA, 330/88 kV and two 60,000 kVA, 330/33 kV 3-phase double wound transformers.

The consulting electrical & mechanical engineers are Messrs. Merz & McLellan.

F FERRANTI

Specify FERRANTI TRANSFORMERS *famous throughout the world*

FERRANTI LTD Head Office and Works: HOLLINWOOD · LANCS
Tel: FAllsworth 2000
London Office: Kern House, 36 Kingsway W.C.2. Tel: TEMple Bar 6666

FERRANTI

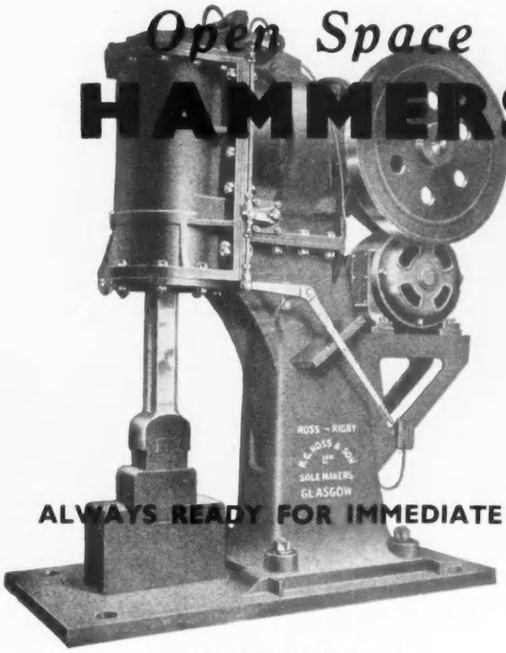
FT224/2

"ROSS-RIGBY"

ELECTRO-PNEUMATIC

Open Space

HAMMERS



ALWAYS READY FOR IMMEDIATE USE

ORIGINAL DESIGNERS AND PATENTEES OF THE FAMOUS "RIGBY'S PATENT" STEAM HAMMER.

ROSS

R. G. ROSS & SON LTD.

EGLINTON ENGINE WORKS
120 TRADESTON STREET
GLASGOW, C.5.

Telegrams—"Glenros, Glasgow" Telephone—South 2283 (4 lines)

TILGHMAN'S

for all your compressor requirements

Two Tilghman's air compressors recently supplied for the Calcutta factory of the Dunlop Rubber Co. Ltd. These machines are of two-crank, double-acting, two-stage design each capable of delivering 500 c.f.m. at 130 lbs. p.s.i. pressure. Attention is directed to the integral intercooler and the centralisation of controls on one face of the machine.

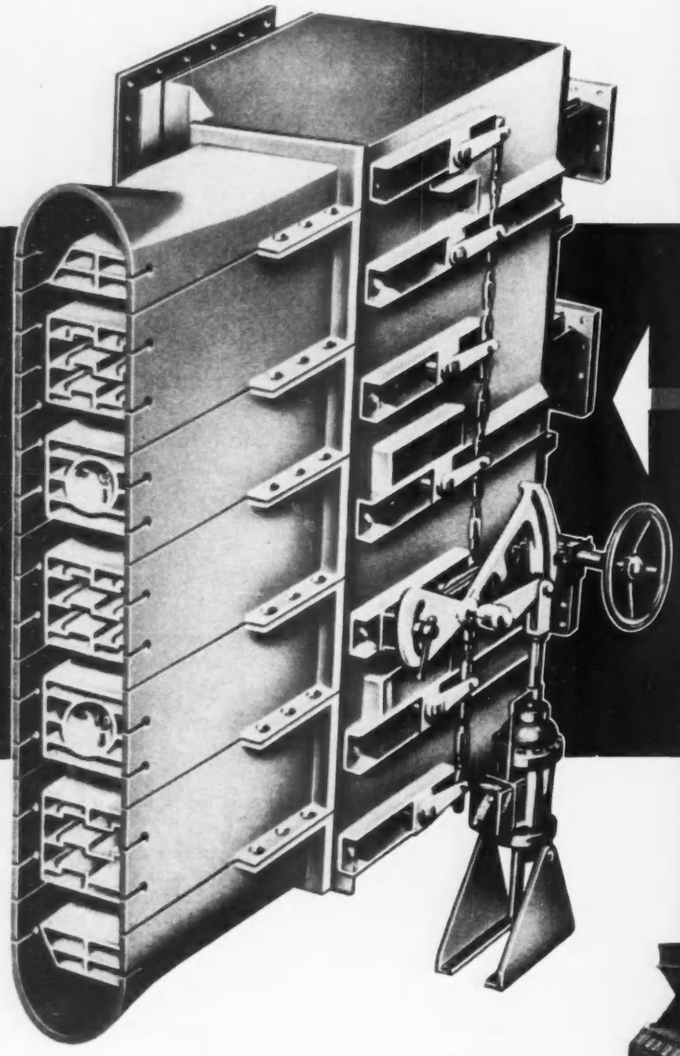
TILGHMAN'S build compressors with capacities up to 6,000 c.f.m. and pressures up to 1,000 lbs. p.s.i.
Vacuum pumps up to 8,000 c.f.m. displacement.

LONDON OFFICE: 1 Chester Street, S.W.1.
A member of the Staveley Coal and Iron Co. Ltd., Group.
AGENTS: MIDLANDS: R. J. Richardson & Sons Ltd., Commercial Street, Birmingham 1.
SCOTLAND: Balbardie Ltd., 227 Bath Street, Glasgow, C.2; 110 Hanover Street, Edinburgh 2.
NORTHERN IRELAND: Stewart Industrial Services Ltd., 16 Sussex Place, Belfast.

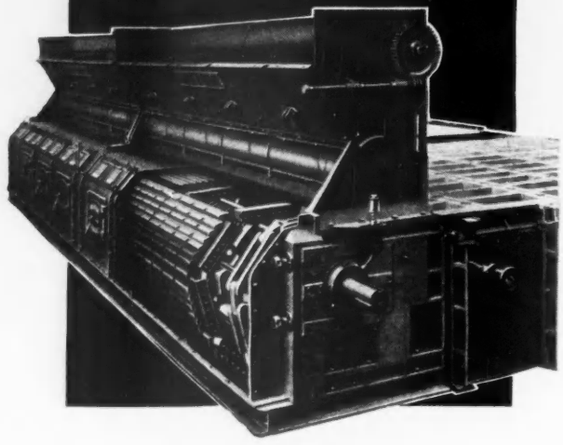
TILGHMAN'S LIMITED BROADHEATH ALTRINCHAM CHESHIRE

W.209

STEAM RAISING
FOR
INDUSTRY



Burner
or
Stoker?



As combustion engineers with considerable experience, IC are able to recommend and supply the most suitable firing equipment for coal, oil or gas to ensure the best possible use of your fuel.

IC

INTERNATIONAL COMBUSTION PRODUCTS LTD.

NINETEEN WOBURN PLACE, LONDON, WC1. WORKS: DERBY

Member of Atomic Power Constructions Limited. One of the Five British Nuclear Energy Groups

TGA 1819

for reliability and long life...

CATERPILLAR* use

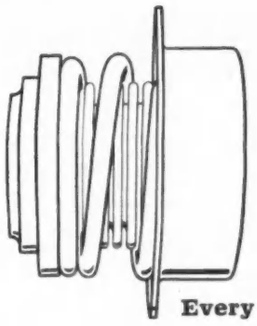
Teddington

shaft seals

No Adjustment ● Hydraulic balance ensures constant sealing pressure giving maximum performance and long life.

No Loose Parts ● The Teddington seal, embodying seamless metallic bellows, has no loose springs or washers and it is easily cleaned and maintained.

No Hard Wear ● Sealing areas under pressure are reduced to a minimum, thus lowering power absorption.



Teddington seals are supplied to suit shafts from ¼" diameter upwards and operate under conditions of high vacuum and pressure. They are efficient up to temperatures of 150°C at low speeds without lubrication. For high speeds and temperatures up to 400°C, lubrication and/or cooling may be necessary.

* Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Every *Teddington* product is backed by 25 years' experience

Ask for leaflet NS5 or call our Advisory Service.

P. W. BAKER & SONS (SALES) LTD., Packless Gland Division, TEDDINGTON WORKS, SUNBURY-ON-THAMES, MIDDX. TEL: SUNBURY-ON-THAMES 456

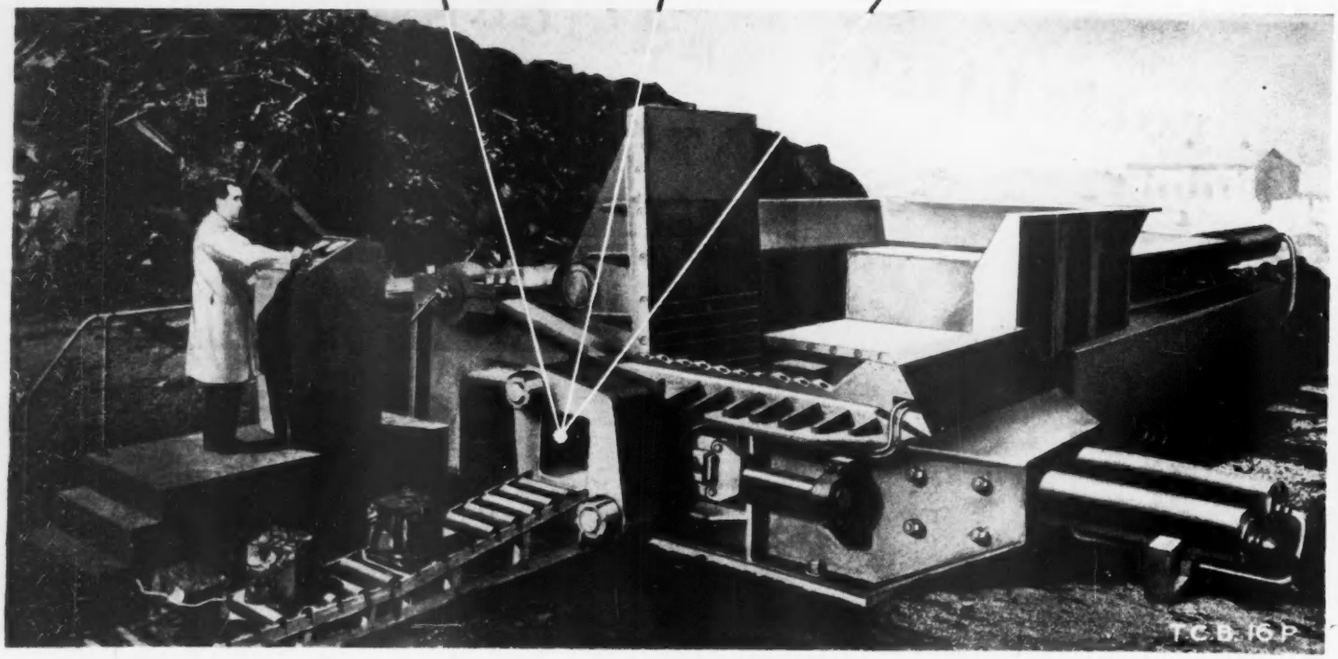
A Member of the Teddington Group of Companies

announcing the latest

FIELDING

High Speed

CUBE BALERS

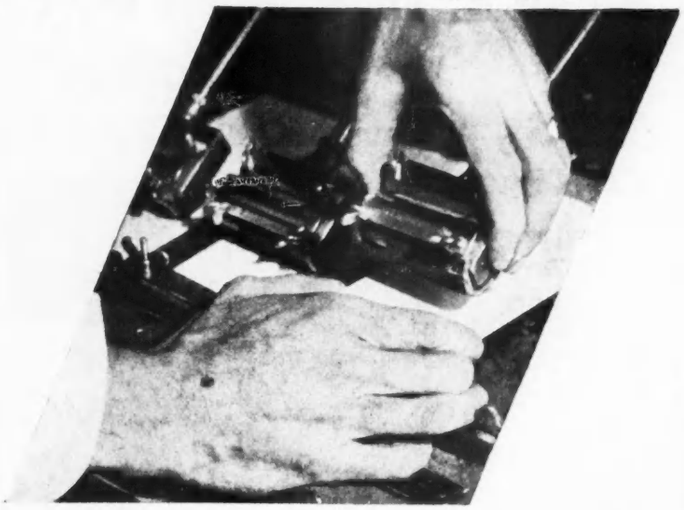


'FIELDING' Cube Balers—with pre-compressing unit—are designed to handle large volumes of general scrap and are especially suitable for the larger scrap yard and factory. Fully self-contained units, they are easily sited on simple block foundations. Press motions may be carried out under Auto-continuous, Cyclic or Hand Control to suit the customer's individual requirements.

Write now for further information and details of these latest FIELDING PRESSES

FIELDING & PLATT LTD · ENGINEERS GLOUCESTER

Are these hands helping *you?*



Test and experimental work in P.J. laboratories, carried out in the hands of qualified paint chemists, is the basis of the expert Technical Advisory Service which is offered to all industrial paint users. The services of these skilled hands are directly available through personal contact with your P.J. technical representative.

You can rely on

PINCHIN JOHNSON

for Paint and Service

PINCHIN, JOHNSON & CO., 4 CARLTON GARDENS, S.W.1

Telephone: TRAfalgar 5600

BELFAST · BIRMINGHAM · BOOTLE · BRIGHTON · BRISTOL · GLASGOW
LEEDS · MANCHESTER · NEWCASTLE-ON-TYNE · SOUTHAMPTON

"TURBINE" (PATENT) FURNACES

USE

ALL GRADES OF SOLID FUEL EFFICIENTLY

ensuring

LOW STEAM RAISING COSTS

May we investigate without charge?

THE TURBINE FURNACE COMPANY LIMITED

238b Gray's Inn Road, London, W.C.1. 'Phone: TERminus 4365

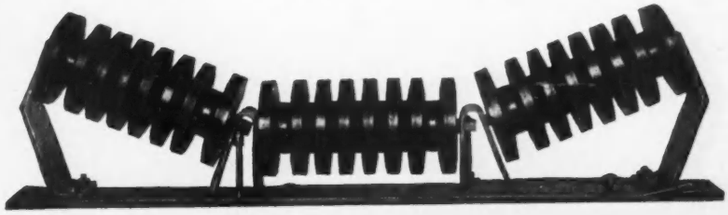
PERFORATED METALS FOR ALL PURPOSES

PooL LTD (EST. 1843)

HAYLE, CORNWALL Tel. Hayle 3213

WD

ELEVATING & CONVEYING MACHINERY

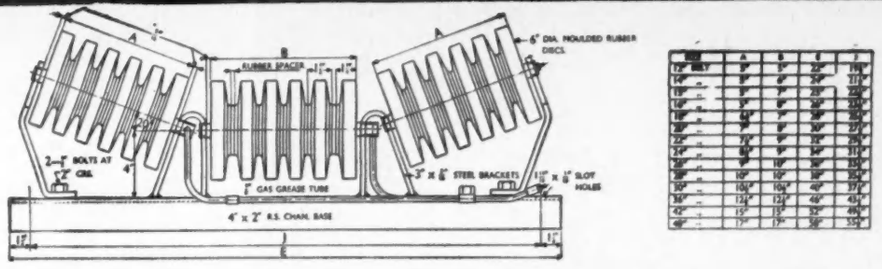


FULLER DETAILS OF IMPACT IDLERS AND OTHER TYPES OF IDLERS AVAILABLE ON REQUEST

Cut replacement costs

Conveyor belts are expensive items. It has been proved that Westwood Dawes Rubber Disc type Impact Resisting Troughing Idlers reduce wear caused by the impact of heavy or abrasive material. It will pay you to fit these resilient idlers at all points of strain and at all loading and transfer points where wear is constant and the going tough.

IMPACT IDLERS PROTECT YOUR CONVEYOR BELTING!


RUBBER SPACER
6" DIA. MOULDED RUBBER DISCS
2—¾" BOLTS AT 4" CRS.
1" GAS GREASE TUBE
3" x ⅜" STEEL BRACKETS
1½" x ⅝" SLOT HOLES
4" x 2" B.S. CHAN. BASE

We also manufacture :—
2, 3, and 5 Roll Standard Troughing Idlers. Flat and Return Belt Idlers. Rubber Disc type Return Idlers. Adjustable Take-Up Units for all duties. Mild Steel fabricated Conveyor Drums of any size AND COMPLETE CONVEYOR INSTALLATIONS.

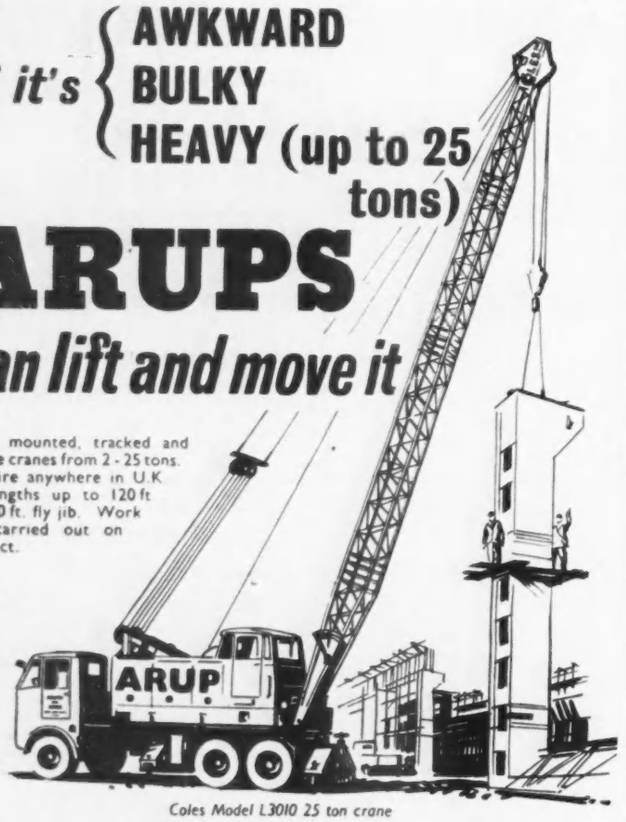
WESTWOOD DAWES & CO. LTD., Bowling Green Road, Stourbridge, Worcs. **Tel: 4741 (4 lines)**

If it's { AWKWARD / BULKY / HEAVY (up to 25 tons)

ARUPS

can lift and move it

Lorry mounted, tracked and mobile cranes from 2 - 25 tons. For hire anywhere in U.K. Jib lengths up to 120 ft. plus 30 ft. fly jib. Work also carried out on contract.



Coles Model L3010 25 ton crane

phone GERRARD 2708 *(5 LINES)*

ARUP & ARUP LTD., COLQUHOUN HOUSE, BROADWICK ST., W.1

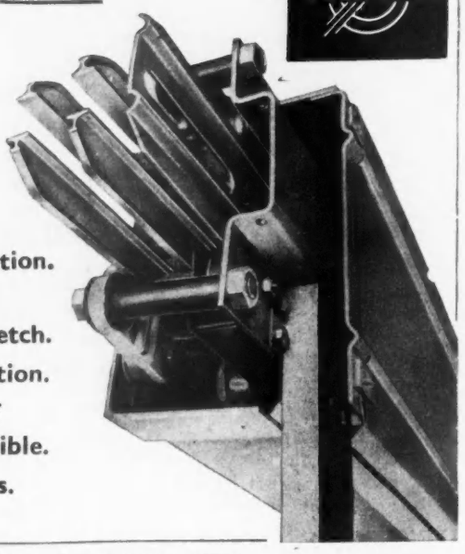
OBERTRAK?

for Safety?

YES, because OBERTRAK CONTACT RAILS are totally enclosed . .

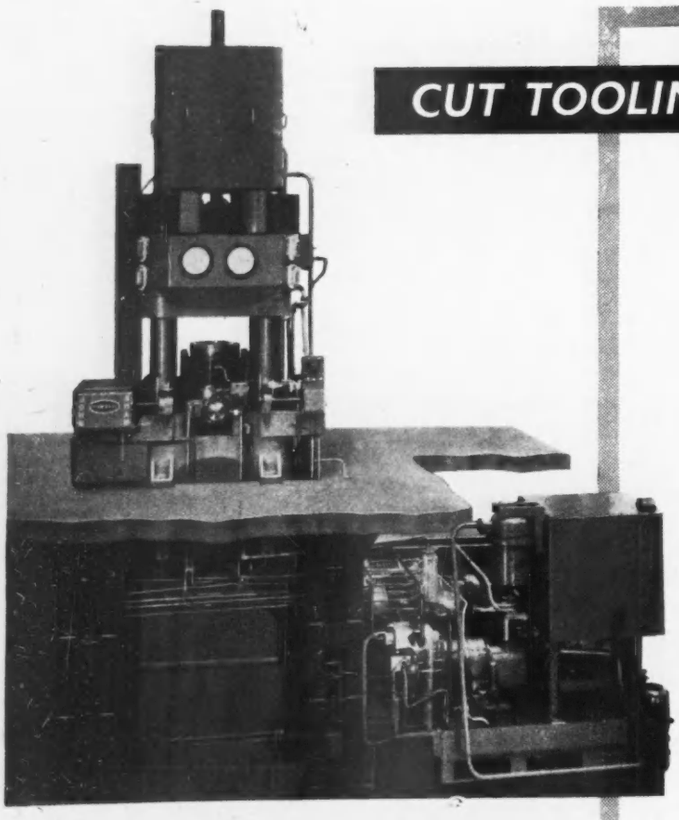
OBERTRAK

Send for descriptive literature



★ Sturdy construction.
★ No wires to stretch.
★ Simple installation.
★ Any number of poles possible.
★ No breakdowns.

J. H. OBERMAN & SONS LTD. HIGHAM FERRERS NORTHANTS
Telephone : RUSHDEN 2162/2844



CUT TOOLING COSTS TO A TENTH

with the sensational new

SHAWDRAW

DEEP DRAWING PRESS

The SHAWDRAW gives accuracy with economy by combining the best features of the steel die and rubber pad processes.

You SAVE—in tooling, a pressurised rubber diaphragm, with pre-set variable pressure/stroke cycle, replacing the female die.
—in labour costs, so foolproof is the design that unskilled labour can safely be used.

You GAIN—amazing accuracy, for spring-back is virtually eliminated and "thinning" is negligible.
—an infinitely improved finish.
—reductions up to 75% under ideal conditions and 60% with D.D.Q. materials normally.

You MUST know more about the SHAWDRAW—write today for full details of this remarkable press.

SHAWDRAW presses are available in 18", 23", *and* 26" *sizes.*

JOHN SHAW & SONS (SALFORD) LIMITED
SALFORD LANCASHIRE

JS 15

GUEST KEEN IRON & STEEL COMPANY

For... FERROUS AND NON-FERROUS

CASTINGS

FOR ALL INDUSTRIES

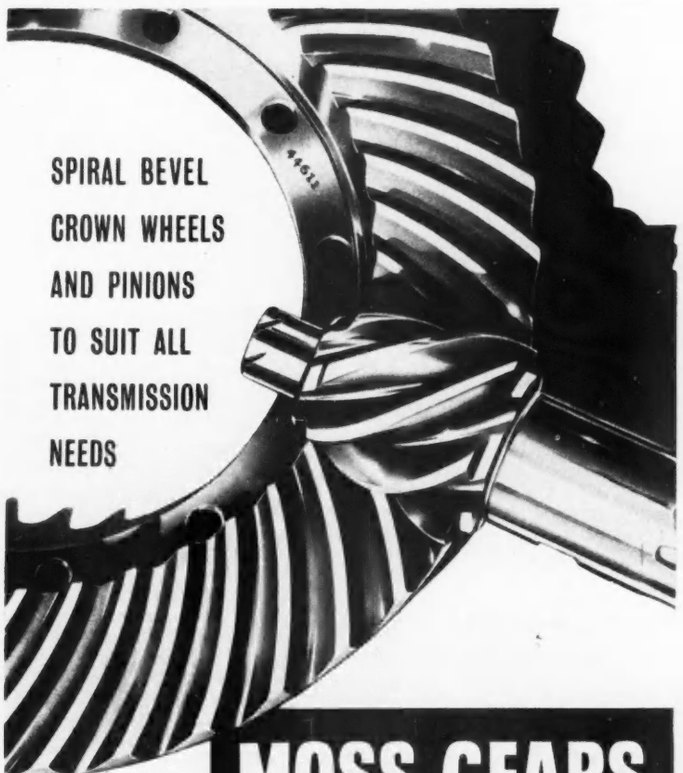
Made with the experience and skill gained by generations of craftsmen at the famous

DOWLAIS WORKS

Telephone: Dowlais 70

GUEST KEEN IRON & STEEL COMPANY LIMITED

HEAD OFFICE: EAST MOORS, CARDIFF. *Phone: Cardiff 33151*

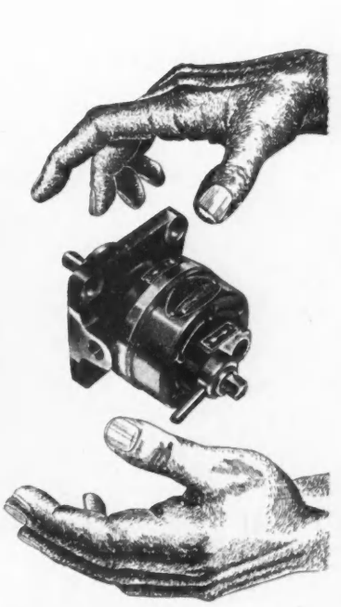


SPIRAL BEVEL CROWN WHEELS AND PINIONS TO SUIT ALL TRANSMISSION NEEDS

MOSS GEARS

MOSS GEAR CO. LTD · CROWN WORKS · TYBURN · BIRMINGHAM · 24

Telephone: ERDington 1661/6 Telegrams: 'Mosgear Birmingham'.



More accurate than human skill itself

Hydraulic Control of motion

Paradoxically, the product of human skill is more accurate than human skill itself. This is particularly so in the case of Savery Hydraulic Pumps. Countless thousands of Savery Pumps are in use throughout the world working with precision that neither human skill nor other means can match. Next time you're considering control of motion remember Savery Hydraulic Pumps first. Savery Pumps can be supplied with fixed or variable delivery.

FOR FURTHER DETAILS OF

SAVERY HYDRAULIC PUMPS

WRITE TO

THOMAS SAVERY PUMPS LIMITED

BRACEBRIDGE STREET, BIRMINGHAM 6 : Telephone: ASTon Cross 1316-7

BRIGHT STEEL

ROUNDS · HEXAGONS

SQUARES · FLATS & SECTIONS

THE HALESOWEN STEEL Co., LTD.

HALESOWEN
Nr. BIRMINGHAM
HALESOWEN 1191

68 VICTORIA St.
LONDON, S.W.1. VIC: 6992
8 CHATHAM St.
MANCHESTER, 1. CEN: 0413

The Wicksteed 8" × 8" Hydramatic is the outstanding 1959 development in Sawing Machines and is the result of over 50 years' experience in metal cutting machine design and manufacture.

It is the most up-to-date advance on the highly successful Hydraulic Resistance type which has been in the lead of quality Sawing Machines for many years.

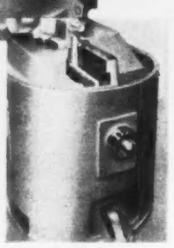
Superior to previous Hack Sawing Machines it is capable of obtaining a greater performance from thinner high-speed steel blades and excels particularly where special alloys and high-tensile steels are used.

The triple-acting hydraulic control unit uses more of the blade and as the teeth are more evenly loaded, gives longer life and greater output per blade.

newest—most advanced metal sawing machine available to-day

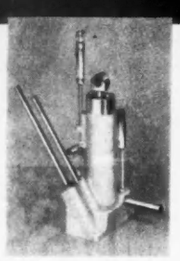
Send for details of the new

WICKSTEED
REGISTERED TRADE MARK
'Hydramatic'
No. 8 — 8" × 8" CAPACITY



All Control Settings and Motor Starter accessible from one position only.

Adjustable motor trip switch allows machine to stop in any position at finish of cutting cycle.



Triple - Acting hydraulic unit enables blade pressure to vary according to section being cut.

Self - priming geared suds pump, totally enclosed, but easily accessible.

CHARLES WICKSTEED & CO. LTD., KETTERING, ENGLAND. Telephone: Kettering 3113/4.

4 FANS

from the world's widest range

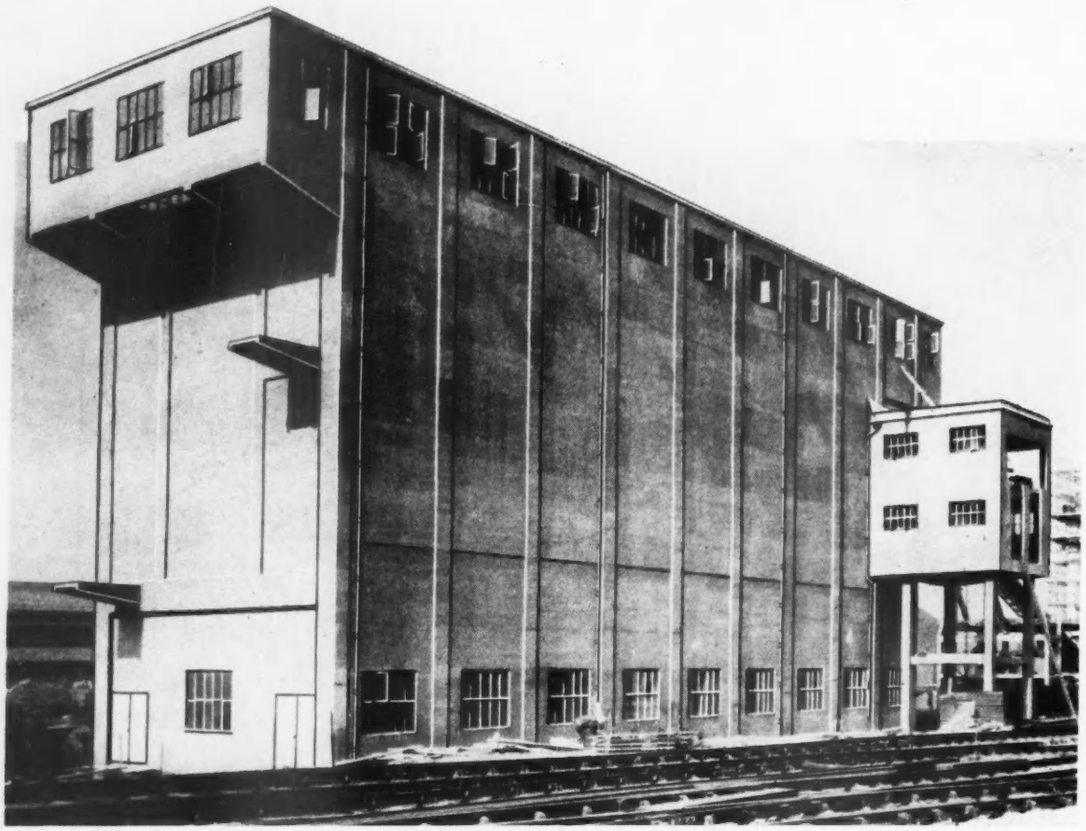
BY MANUFACTURERS OF FANS FOR INDUSTRY SINCE 1883

Ask for fully illustrated Publication 25/1 "Heavy Fan Engineering". It covers the large and heavier classes of equipment in the 'Tornado' range including

CENTRIFUGAL FANS · MILL EXHAUSTERS
INDUCED DRAUGHT FANS · ALTERNATOR COOLERS
PRIMARY AIR FANS · GAS BOOSTERS · TURBO BLOWERS
AXIAL FANS · MINE VENTILATING FANS

Keith Blackman Ltd. MILL MEAD ROAD, LONDON N.17 Tel: TOTtenham 4522
(incorporating Blackman Export Co. Ltd.)
and at BIRMINGHAM · BRISTOL · GLASGOW · LEEDS · LEICESTER · MANCHESTER · NEWCASTLE-ON-TYNE

CIVIL ENGINEERING CONTRACTORS

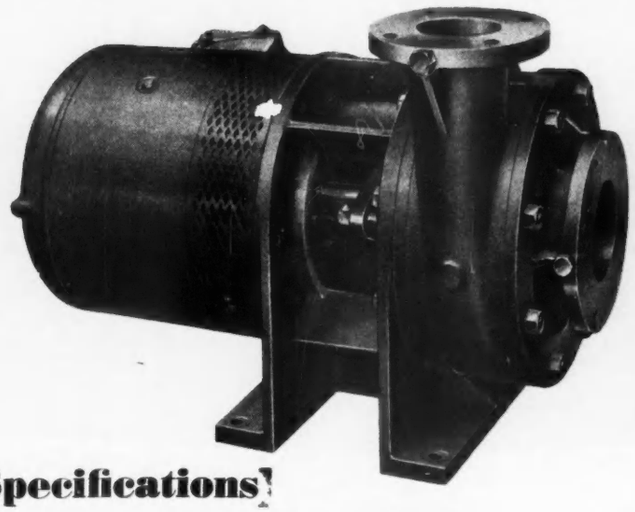


REINFORCED CONCRETE STRUCTURES
HEAVY CONCRETE FOUNDATIONS
PILING · ROADS · WHARVES
GENERAL CIVIL ENGINEERING WORK

E. E. JEAVONS & CO. LTD.

TIPTON · STAFFORDSHIRE

Telephone : TIPTON 2161 (6 lines) *Telegrams : " PIPELINES" TIPTON*



Specifications to suit a variety of duties

These Safran Unishaft electric pumps offer, in addition to their performance, a robustness that ensures long service, compactness that requires minimum installation space and, by the absence of bedplates and pedestals, a mere fractional footing for firm anchorage. Standard specification and stock sizes ¾"/1" to 2"/2½". Full range extends to 5"/6".

SAFRAN REGISTERED TRADE MARK PUMPS

MAKERS ALSO OF MULTISTAGE, SELFPRIMING, TRUNK, DEEPWELL, SUMP & WATER CIRCULATOR PUMPS

SAUNDERS VALVE COMPANY LIMITED
SAFRAN PUMP DIVISION
DRAYTON STREET, WOLVERHAMPTON. PHONE 25531

FLAMEPROOF SOLENOID OPERATED VALVES

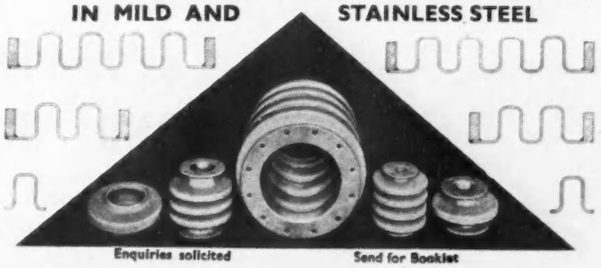
BUXTON CERTIFIED

Pressure Ranges ... ... 0–5" W.G.
0–5 P.S.I.
0–15 do
0–150 do
Bores ¼" to 4" ... ... 0–1500 do
Voltages D.C. 24v. to 550v.
A.C. 100v. to 600v.
WITH INTEGRAL RECTIFIERS

MAXSEAL VALVES LTD
WOOD ROAD, KINGSWOOD, BRISTOL
Phone: Bristol 67-3869

ROSE'S EXPANSION PIECES

PRESSED STEEL BELLOWS TYPE IN MILD AND STAINLESS STEEL



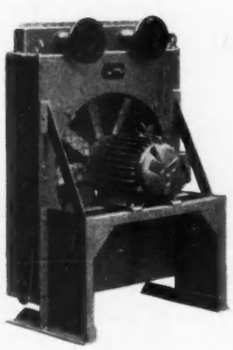
Enquiries solicited Send for Booklet

also AIR RECEIVERS, CHIMNEYS, TANKS, PIPE WORK, PRESSURE CYLINDERS, AND FABRICATED STEEL PLATEWORK

BRITISH APPLIANCES MFG. CO., LTD.
DOLLY LANE, LEEDS, 9
Telephone: 30725 Telegrams: STRUCTURAL LEEDS 9

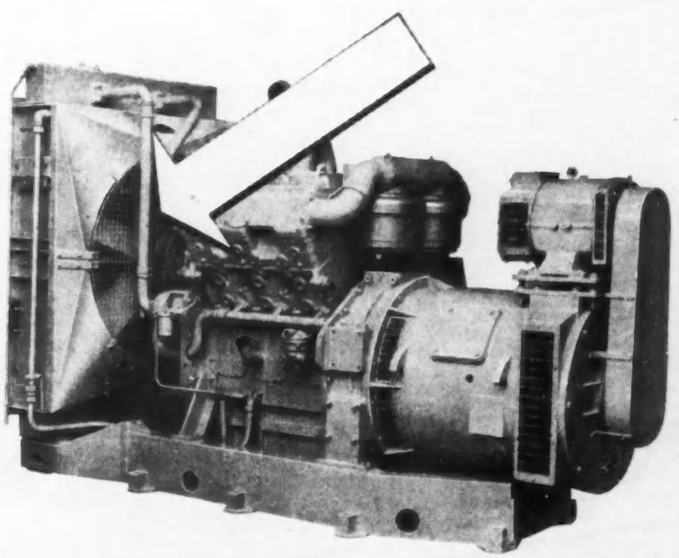
ENGINE COOLING IS OUR BUSINESS

Backed by fifty years of technical experience and "know-how," Spiral Tube Engine Coolers are soundly engineered and robustly constructed for long, trouble-free service, and are renowned for their high efficiency and great resistance to vibration. They have a wide range of applications and are in world-wide service on all the principal railways throughout the world. Coolers are also manufactured for use in connection with generators, alternators, etc.



COOLED BY SPIRAL TUBE Air Blast Compressed Air Cooler.

★ *Consult our Technical Advisory Service*



COOLED BY SPIRAL TUBE, Paxman 6: R.P.H. Standard Alternator Set with G.E.C. electrical equipment 125 K.W. at 1,000 R.P.M.

SPIRAL TUBE
Engine Coolers

THE SPIRAL TUBE & COMPONENTS COMPANY LIMITED, OSMASTON PARK ROAD, DERBY. TELEPHONE: DERBY 48761 (3 lines)
LONDON OFFICE: ABBEY HOUSE, 16 HIGH STREET, WATFORD. TELEPHONE: 26781-2. GRAMS: SPIRATUCOM WATFORD

N

SPECIALISED

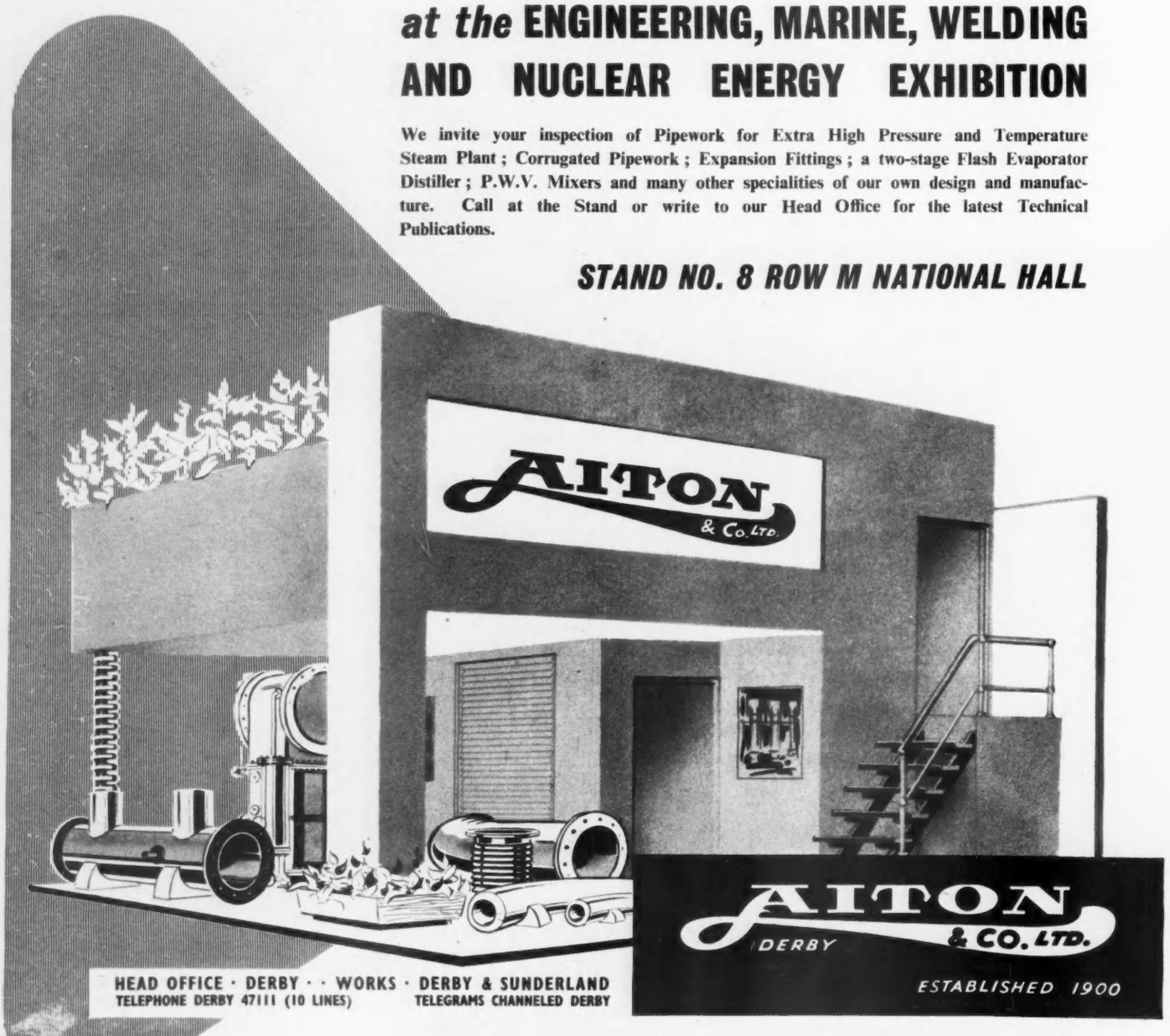
PIPEWORK

Ancillary Equipment and Evaporator Distillers

at the ENGINEERING, MARINE, WELDING AND NUCLEAR ENERGY EXHIBITION

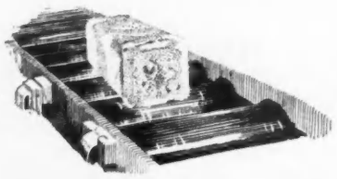
We invite your inspection of Pipework for Extra High Pressure and Temperature Steam Plant ; Corrugated Pipework ; Expansion Fittings ; a two-stage Flash Evaporator Distiller ; P.W.V. Mixers and many other specialities of our own design and manufacture. Call at the Stand or write to our Head Office for the latest Technical Publications.

STAND NO. 8 ROW M NATIONAL HALL



HEAD OFFICE · DERBY · · WORKS · DERBY & SUNDERLAND
TELEPHONE DERBY 47111 (10 LINES) TELEGRAMS CHANNELED DERBY

PIPEWORK ENGINEERS

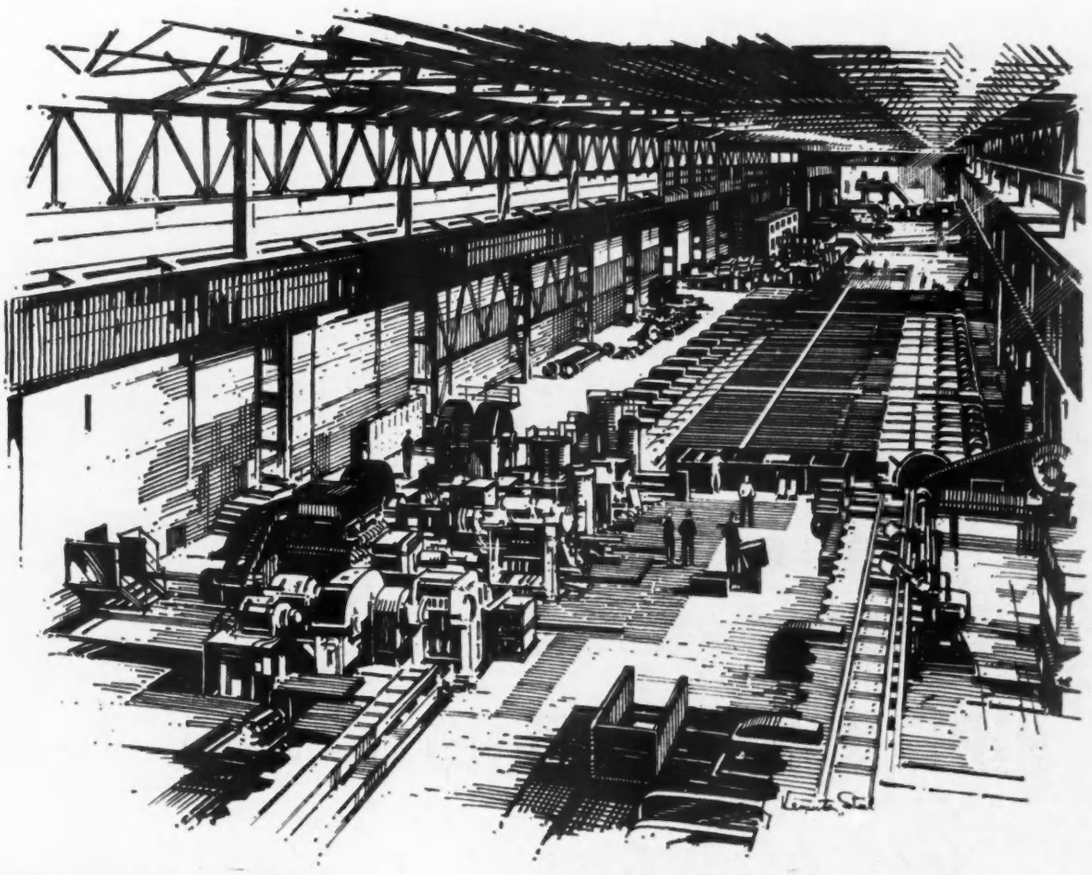


The path of an ingot

THE BILLET MILL

Billets are the raw material from which many products are later rolled, sections, bars, wire rod and the like.

Modern practice is to produce them by continuous methods, so that progression from ingot to finished product may be carried out through all operations without the necessity of reheating. This principle is clearly portrayed in the illustration, which shows a 10-Stand Morgan Continuous Billet and Slab Mill, arranged in two groups of six and four stands respectively, fed by a 44" Davy-United Blooming and Slabbing Mill capable of an output of some 22,000 tons per week.



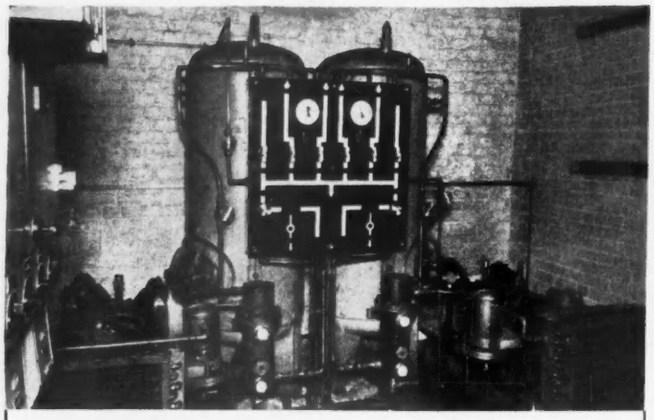
Builders of Capital Equipment for the Metals Industries

DAVY-UNITED

218/P

SHEFFIELD, MIDDLESBROUGH, GLASGOW

It's just plain good sense to fit Vokes filters in your air lines

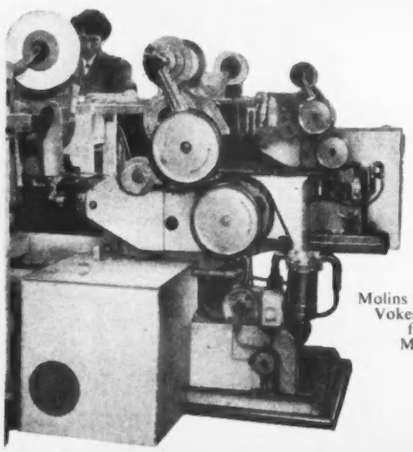


SWITCHGEAR: Vokes C.P.H. filters fitted in an air-operated switchgear room at Kingston power station.

Yes . . . it's good sense to protect air-using plant and machinery against damage, when the protection costs so little. Vokes standard pipe-line filters for instance at strategic points along the line, prevent water, scale and rust from reaching compressed air tools and causing early breakdown and loss of efficiency.

And for special applications, such as in the manufacture and processing of chemicals and food, the packing of cigarettes, there are Vokes pipe-line filters with special silver grey paper elements, excluding not only the "major menaces" but also oil mist and minute particles of foreign matter which present a hazard to the product or the process.

Fit Vokes pipe-line filters—maintain them regularly—and their installation will be repaid a hundred times over.



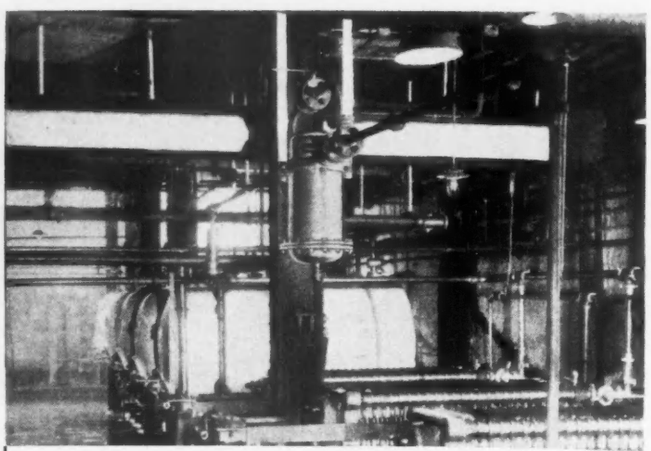
CIGARETTE PACKING

Molins packing machine, showing Vokes Compressed Air Pipeline filter (Photo by courtesy of Messrs. W. D. & H. O. Wills)

VOKES

PIPE LINE FILTERS

Give protection all along the line



BREWERIES: Vokes filters in the airlines of William McEwen & Co. Ltd.'s Edinburgh brewery – ensure that beer is best!

VOKES LIMITED · GUILDFORD · SURREY

Telephone : Guildford 62861 (6 lines). Grams & Cables : Vokesacess, Guildford, Telex. Telex : 13-535 Vokeacess, Gfd.

Vokes Australia Pty. Ltd., Sydney. *Represented throughout the World.*

VOKES— Air and Gas Filters for Chemical, Nuclear Energy, Oil Refinery, and Pharmaceutical applications etc; Air conditioning filters; Compressed air pipe line filters; Air, Oil and Fuel filters for Diesel, Gas Turbine, and other ijc engines; Hydraulic filters; Silencers for Engines, Fans and Blowers; High efficiency Multi Cyclones.

V334

CLASSIFIED ADVERTISEMENTS

AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS

Lineage Rate. 4/- per line of approximately 6 words. Minimum 16/-.

Inch Rate. 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING

Lineage Rate. 3/6 per line of approximately 6 words. Minimum 14/-.

Inch Rate. 42/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page. (12 column inches) and upwards, e.g. ¼-page £22. ½-page £41 10s. Full page £78.

Series Discounts. For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/- which includes forwarding of replies.

Copy Dates. "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*—Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

Urgent advertisements may be telephoned to CENtral 6565

PUBLIC APPOINTMENTS

BRADFORD INSTITUTE OF TECHNOLOGY

Principal: E. G. EDWARDS, Ph.D., B.Sc., F.R.I.C.

APPOINTMENTS

Expansion of the work of the Institute, especially in courses for the Diploma in Technology, has created vacancies in the various departments and applications are invited for the posts of :

READERS, SENIOR LECTURERS and LECTURERS in MECHANICAL ENGINEERING and CIVIL ENGINEERING.

Successful candidates will be given adequate facilities to undertake and direct research, and suitable technical assistance and equipment are available. Senior members of staff are encouraged to undertake consultant work in industry and may retain fees paid for such work.

The grading of the appointments will depend upon qualifications and experience and the salary scales for men will be in accordance with the Burnham Technical Award as follows :

Reader : £1627 10s. to £1890 per annum.
Senior Lecturer : £1417 10s. to £1627 10s. per annum.
Lecturer : £1260 to £1417 10s. per annum.

In the case of very highly qualified applicants for the post of Reader, the Governors may, subject to agreement by the Ministry of Education, pay such higher salary above the maximum of the scale as would be appropriate.

Previous industrial or research experience at a suitable level will be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar, Bradford Institute of Technology, Bradford, 7.

W. H. LEATHEM,
Clerk to the Governors.

E5529

REPUBLIC OF THE SUDAN

SENIOR LECTURERS AND LECTURERS

The Ministry of Education invite applications from those suitably qualified to fill posts of SENIOR LECTURERS and LECTURERS in the following departments in the Khartoum Technical Institute :

(a) Civil Engineering.
(b) Mechanical and Electrical Engineering.

QUALIFICATIONS

A Degree in Civil Engineering, Mechanical or Electrical Engineering, or the technical equivalent, e.g. A.M.I.Mech.E., A.M.I.E.E., A.M.I.C.E., &c.

Teaching experience in a similar appointment is desired. Applicants must be able to read, write and speak English to the standard which would enable them to carry out the duties of the posts.

Age limit 25–45 years. Candidates beyond the upper limit may in special circumstances be considered.

DUTIES

Successful candidates will be required to teach their subjects to Higher National Certificate level and also to supervise workshop and laboratory activities.

TERMS OF SERVICE

Appointment will be on contract with bonus for a period of five years. Salary scale ranges for Senior Lecturers from £S.1075 to £S.1975, and for Lecturers from £S.1075 to £S.1675. Point of entry into the scale will be determined by age, qualifications and experience. A cost-of-living allowance which is reviewed every two months is payable, together with an initial outfit grant of £S.50 on appointment.

Annual leave accrues at the rate of 7 days per month, with free air passage on appointment and leave.

Applications should be made in the first instance in writing, giving fullest particulars of age, qualifications and experience, together with two copies of recent testimonials, and addressed to the Sudan Embassy, Personnel Section, Cleveland Row, St. James's, London, S.W.1, quoting reference L.O. 3001 4/1027. Closing date, May 15, 1959.

E5576

UNIVERSITY OF LIVERPOOL

ASSISTANT LECTURER OR LECTURER

Applications are invited for the post of ASSISTANT LECTURER or LECTURER in the Department of Electrical Engineering. The initial salary will be within the range £700–£1250 per annum.

Applications, stating age, academic qualifications and experience, together with the names of three referees, should be received not later than 18th May, 1959, by the Registrar, from whom further particulars of the conditions of appointment may be obtained.

E5559

PUBLIC APPOINTMENTS

COUNTY BOROUGH OF ROTHERHAM EDUCATION COMMITTEE

ROTHERHAM COLLEGE OF TECHNOLOGY

LECTURERS

Applications are invited for the undermentioned posts, duties to commence on 1st September, 1959.

DEPARTMENT OF MATHEMATICS

LECTURER (Man or Woman), to teach Mathematics in National Certificate and Higher National Diploma (Sandwich) courses.

Applications will also be considered from candidates with main qualifications in engineering who are interested in the teaching of Mathematics.

DEPARTMENT OF MECHANICAL, PRODUCTION AND CIVIL ENGINEERING

SENIOR LECTURER, to teach Mechanical Engineering subjects to Higher National Diploma (Sandwich) and Degree standard. Candidates should possess a Degree or equivalent qualification and have had appropriate industrial and teaching experience.

LECTURER, to teach Mechanical Engineering subjects in Higher National Certificate and Higher National Diploma (Sandwich) Courses.

Candidates should possess a Degree or equivalent qualification and have had appropriate industrial and teaching experience.

Salaries will be in accordance with the Burnham Further Education Report, 1956 :

Senior Lecturer : £1417 10s. by £52 10s. to £1627 10s.
Lecturer : Man : £1260 by £31 10s. to £1417 10s.
Woman : £1188 by £29 14s. to £1336 10s., plus equal pay increments.

Application forms and further particulars may be obtained from the undersigned, to whom completed forms should be returned within 14 days of the appearance of this advertisement.

R. BLOOMER,
Director of Education.

Education Offices,
Rotherham.
17th April, 1959.

E5584

NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY, ST. JOHN STREET, LONDON, E.C.1

AERONAUTICAL ENGINEERING—APPOINTMENT OF HEAD OF DEPARTMENT

The College is one of the eight Colleges of Advanced Technology. It is concerned with Full-time Degree, Sandwich Diploma-in-Technology and Advanced Courses in Engineering and Science.

The Governing Body invites applications for the HEADSHIP of a new department of AERONAUTICAL ENGINEERING. The person appointed will be required to organise the considerable volume of existing advanced work (including Structures, Aerodynamics and Propulsion), and to develop post-graduate courses and research projects. He will be encouraged to maintain contact with industry, e.g., as consultant, by membership of advisory committees, &c.

Applicants should be well-qualified professionally and must have had recent industrial experience.

The salary scale is the Burnham Grade V, i.e. £2032 by £52 10s. to £2202 per annum.

Forms and further particulars available from the Secretary.

J. S. TAIT, Ph.D., B.Sc. (Eng.), M.I.E.E., M.I.Mech.E.

E5586

LONDON COUNTY COUNCIL

WOOLWICH DAY COLLEGE
VICARAGE ROAD, S.E.18.

GRADE "A" ASSISTANT

For Workshop Practice to Intermediate Standard City and Guilds Mechanical Craft Practice Course ; some teaching in First and Second Years of C. & G. M.S.E. Course. Burnham F.E. Scale, £498 15s. by £26 5s. to £945 (Man), plus London Allowance ; additions for qualifications and training ; increments within scale for approved experience. Forms and details from Principal at College to be returned by 1st May. (837)

E5533

PUBLIC APPOINTMENTS

UNIVERSITY OF LIVERPOOL

DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for the following posts in the Department of Mechanical Engineering :

TWO POSTS of DEMONSTRATOR. The initial salary will be within the range £500–£650 per annum.

ASSISTANT LECTURER or LECTURER. The initial salary will be within the range £700–£1250 per annum, according to age, qualifications and experience.

Applications, stating age, academic qualifications and experience, together with the names of three referees, should be received not later than 2nd May, 1959, by the Registrar, from whom further particulars of the conditions of appointment may be obtained.

E5527

SOUTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

REGIONAL ENGINEER'S DEPARTMENT

ENGINEERING ASSISTANT (MECHANICAL)

Applications are invited for the following appointment on the permanent staff of the Board's Regional Engineer generally in accordance with the Whitley Council conditions of service.

ENGINEERING ASSISTANT (MECHANICAL) Commencing salary within the scale (Grade II), £545 (at age 21 or over) by £20 (3) by £25 (4) by £30 (2) to £765, for candidates possessing O.N.C. or equivalent, or (Grade I), £680 (at age 23 or over) by £25 (3) by £30 (1) by £35 (4) by £40 (2) to £1005, for candidates possessing H.N.C. or equivalent, plus London Weighting allowance in addition to both scales.

Application forms may be obtained from the undersigned at 40, Eastbourne Terrace, London, W.2, and must be returned completed by not later than 2nd May, 1959.

E. G. BRAITHWAITE,
Secretary.

E5557

MINISTRY OF SUPPLY

SOUTH MARSTON, SWINDON, WILTS.

TECHNICIAN

Ministry of Supply require TECHNICIAN at South Marston, Swindon, Wilts, to act as member of Ministry of Supply team resident at a Contractors' works and be responsible for the supervision of inspection during the development, production and repair of aircraft.

Qualifications : Recognised engineering apprenticeship. O.N.C., appropriate C. and G. Final Certificates or equivalent qualifications desirable. Considerable experience of aircraft construction and assembly. Good knowledge of aircraft hydraulic and mechanical systems necessary and some experience of electrical installations an advantage.

Rate of Pay : £850 (age 30) to £1005 per annum.

Application forms from Ministry of Labour and National Service (P.E. 867), Professional and Executive Register, Atlantic House, Farringdon Street, London, E.C.4.

E5568

BOROUGH OF WATFORD

DEPUTY WATER ENGINEER AND MANAGER
GRADE A.P.T. V

Applications for the above appointment are invited from suitably experienced and qualified engineers. An "essential user's" car allowance will be payable, and it is thought that housing accommodation may be available for the successful candidate, if required.

The appointment will be subject to the Local Government Superannuation Acts and to the passing of a medical examination. Further particulars of the appointment and details of the Watford Water Undertaking may be obtained from the Water Engineer and Manager, Town Hall, Watford. Closing date for applications 9th May, 1959.

GORDON H. HALL,
Town Clerk.

Town Hall,
Watford.
17th April, 1959.

E5598

PUBLIC APPOINTMENTS

SOUTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

REGIONAL ENGINEER'S DEPARTMENT

ASSISTANT ENGINEER (MECHANICAL)

Applications are invited for the following appointment on the permanent staff of the Board, generally in accordance with the Whitley Council conditions of service.

ASSISTANT ENGINEER (MECHANICAL).—Applicants should have served a recognised engineering apprenticeship and must be Graduate Members of the Institution of Mechanical Engineers, and have passed A and B of the Associate Membership examination, or hold exempting qualifications. Corporate Membership of the Institution of Heating and Ventilating Engineers will qualify. Sound experience of design of mechanical services of large buildings required. Drawing-office and estimating experience an advantage.

Salary : £730 by £25 (2) by £30 (2) by £35 (5) by £40 (1) to £1055 per annum, plus London Weighting allowance of £20–£50 per annum. The commencing salary may be fixed above the minimum of the scale for relevant practical experience.

Application forms may be obtained from the undersigned at 40, Eastbourne Terrace, London, W.2, and must be returned completed by not later than 2nd May, 1959.

E. G. BRAITHWAITE,
Secretary.

E5552

CIVIL SERVICE COMMISSION

GOVERNMENT SCIENTIFIC ESTABLISHMENTS

RESEARCH FELLOWSHIPS

RESEARCH FELLOWSHIPS (3 years) in Government Scientific Establishments. Value : £1100–£1350 (Senior) and £750–£1000 (Junior). Very wide range of topics, especially in the Physical Sciences. A few opportunities for BIOLOGISTS, e.g. in Virology, Taxonomy and Physiology as applied to Fisheries and Veterinary Research.

Qualifications : normally First or Second Class Honours Degree ; evidence of high standard of ability in research ; and at least 2 years' post-graduate research experience (3 years for Senior Fellowships.) No age limits. F.S.S.U.

Write, Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S4932/59.

E5554

CIVIL SERVICE COMMISSION

PATENT EXAMINERS AND PATENT OFFICERS

Pensionable posts for men or women for scientific, technical and legal work on Patent Applications. Age at least 21 and under 28, with extension for regular Forces Service and Overseas Civil Service.

Qualifications : normally First or Second Class Honours Degree in Physics, Chemistry, Engineering or Mathematics, or equivalent attainment, or professional qualification, e.g. A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.R.I.C. London salary : (men) £665–£1460 ; provision for starting pay above minimum. Promotion prospects.

Write, Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S128/59.

E5555

NORTHERN IRELAND HOSPITALS AUTHORITY

HEADQUARTERS ENGINEERING STAFF (MECHANICAL AND ELECTRICAL)

(a) SENIOR ASSISTANT ENGINEER : £1010 by £30 (5) by £35 (1) to £1195 per annum.
(b) ASSISTANT ENGINEER :
Grade I : £930 by £30 (3) to £1020 per annum.
Grade II : £840 by £30 (3) to £930 per annum.
Grade III : £740 by £25 (4) to £840 per annum.

Application forms and particulars may be obtained from the Secretary, Northern Ireland Hospitals Authority, 27, Adelaide Street, Belfast, to whom completed forms should be returned so as to arrive not later than 11th May, 1959.

E5585

Classified Advts. continued on page 120

PUBLIC APPOINTMENTS

NEWCASTLE REGIONAL HOSPITAL BOARD

APPOINTMENTS

Applications are invited for the following posts on the staff of the Regional Engineer :

ASSISTANT ENGINEER—HEATING AND VENTILATING

Salary scale : £730 by £25 (2) by £30 (2) by £35 (5) by £40 (1) to £1055 per annum.

Applicants should have passed the appropriate sections of the Associate Membership Examination of the Institution of Mechanical Engineers or should be Associate Members of the Institution of Heating and Ventilating Engineers.

ENGINEERING ASSISTANTS—HEATING AND VENTILATING

Salary scale : Grade I, £680 by £25 (3) by £30 (1) by £35 (4) by £40 (2) to £1005 per annum ; or Grade II, £545 by £20 (3) by £25 (4) by £30 (2) to £765 per annum.

The point of entry being in accordance with age, experience and technical qualifications. Applicants should have served a recognised engineering apprenticeship, having obtained a Higher National Certificate in Mechanical Engineering for Grade I post or an Ordinary National Certificate in Mechanical Engineering for Grade II post, or have otherwise passed an examination approved by the Ministry of Health.

The work is varied and interesting. It includes all types of central heating, hot water supply air conditioning plant, fully automatic sterilising equipment for Operating Theatres and more general sterilising equipment for Wards, Treatment Rooms and Clinics.

Candidates should be expert draughtsmen with experience in design work, preparation of working drawings and specifications, including details of equipment. The candidate would be expected to prepare the whole of the engineering services for large building projects.

Applications, stating age, qualifications, experience and present and previous appointments, together with the names and addresses of three referees (two technical), should be forwarded to the Secretary to the Board, Benfield Road, Newcastle upon Tyne, 6, within 14 days. E5507

UNITED LIVERPOOL HOSPITALS

LIVERPOOL ROYAL INFIRMARY

SENIOR ENGINEER

Applications are invited for the post of SENIOR ENGINEER at the Liverpool Royal Infirmary (374 beds). The person appointed will be responsible to the Superintendent Engineer of the group for the operation and maintenance of the engineering plant and services and for the supervision of the building and engineering maintenance staff. Candidates should possess a Ministry of Transport and Civil Aviation (ex-Board of Trade) First Class Certificate of Competency in Marine Engineering or a recognised equivalent qualification. Practical experience in hospital engineering is desirable. The salary scale is £680 per annum, rising in five yearly increments to £815 per annum. Whitley Council terms and conditions of service apply.

Apply by 9th May, 1959, stating age, qualifications, experience and the names of three persons to whom reference may be made to the Secretary, The United Liverpool Hospitals, 80, Rodney Street, Liverpool, 1. E5581

CIVIL SERVICE COMMISSION

MECHANICAL AND ELECTRICAL ENGINEERS

Pensionable posts for men and women normally under 35 on 1st March, 1959. Applicants must normally have Degree in Engineering or Physics (or Dip. Tech. for some posts), or have passed examinations necessary for A.M.I.Mech.E., A.M.I.E.E., A.F.R.Ae.Soc., &c. Exceptionally, evidence of high professional attainment acceptable in lieu. Practical training and experience required but untrained graduates acceptable for some posts. Men's starting salary (London) from £830 (lower if under 25) to £1125. Maximum £1300. Promotion prospects.

Write, Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S85/59/9. Closing date, 13th May, 1959. Earlier applicants may be interviewed before that date. E5567

EAST WORCESTERSHIRE WATERWORKS COMPANY

ENGINEER-MANAGER

Applications are invited for the appointment of ENGINEER-MANAGER. Candidates must be fully and suitably qualified and with the necessary experience of waterworks practice and administration, between the ages of about 45–50 years.

The salary will be £2500 per annum, rising to £3000 per annum.

The successful candidate will be required to pass a medical examination and to join the Company's superannuation scheme under the Worcestershire County Council.

Applications, giving the names of three persons to whom reference may be made, should be addressed to A. M. Hardy, F.C.I.S., Secretary, 2, Stourbridge Road, Bromsgrove, Worcestershire, to be received by 20th April, 1959, and endorsed " Engineer-Manager." E5469

PUBLIC APPOINTMENTS

CIVIL SERVICE COMMISSION

SENIOR SCIENTIFIC OFFICERS (A) : SCIENTIFIC OFFICERS (B)

Pensionable posts for men and women in all major scientific fields including Physics, Chemistry, Biology, Meteorology, Mathematics. Specially needed are :—

PHYSICISTS for research in physical oceanography ; determination of atomic constants from nuclear magnetic resonance, &c. ; microwave studies ; speech characteristics ; computer design.

PHYSICIST-MATHEMATICIAN for Civil Defence problems.

MATHEMATICIAN for problems in the communications field.

GEOPHYSICIST (frequent overseas surveys).

INDUSTRIAL PHYSIOLOGIST.

CHEMISTS for research in organic and/or biochemistry for plant protection ; reaction kinetics ; radiation chemistry ; modern analytical technique (especially spectrography and chromatography).

BIOLOGISTS for taxonomy of invertebrate animals ; fungus systematics ; plant pathology ; taxonomic botany (Pteridophyta) ; orchidology ; palaeobotany.

ENGINEERS for research on road construction and traffic flow ; wind pressures on buildings ; application of servo-control to machine tools.

TAXONOMIC BOTANIST to specialise on Mosses.

HANDWRITING EXPERT for Forensic Science Laboratory.

Qualifications : normally First or Second Class Honours Degree in Science, Mathematics or Engineering, or equivalent attainment ; additionally, for (a), at least 3 years' relevant (e.g. post-graduate) experience. Normal age limits : (a) between 26 and 31 ; (b) between 21 and 28, with extension for regular Forces Service and Overseas Civil Service. London salaries (men) : (a) £1233–£1460 ; (b) £655–£1150 ; provision for starting pay above minimum. Promotion prospects.

Write, Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting : (a) S53/59 ; (b) S52/59. E5553

GOVERNMENT OF NORTH BORNEO

PUBLIC WORKS DEPARTMENT

ELECTRICAL ENGINEER

For duty as Government Inspector under the Electricity Ordinance ; organising and managing a small repair workshop for domestic and other electrical equipment, the servicing of such equipment and the investigation, design and construction of small electrical installations.

Contract appointment for three years in salary range £1302 to £2324 p.a. with gratuity payable on satisfactory completion of contract. Free passages. Quarters at low rent. Generous home leave.

Candidates, over 28 years, must be A.M.I.E.E. or possess qualifications exempting them from the Institution's examinations, with at least 5 years' practical experience in rural and urban distribution systems and repair and service of domestic and light industrial electrical equipment, especially air conditioning equipment.

Write Director of Recruitment, Colonial Office, London, S.W.1, giving age, qualifications and experience, quoting BCD 112/21/018. E5521

THURROCK URBAN DISTRICT COUNCIL

ENGINEER AND SURVEYOR'S DEPARTMENT

ENGINEERING ASSISTANT

Thurrock Urban District Council (Engineer and Surveyor's Department) require ENGINEERING ASSISTANT. Salary within A.P.T. I/II, i.e., £575–£845 p.a. Candidates should have completed their Training in a Municipal or Civil Engineer's Office and have had some subsequent experience. Appointment pensionable. Applications, stating age, qualifications and experience, and quoting three referees, to Clerk of the Council, Council Offices, Grays, by 28th April, 1959. Canvassing disqualifies. Relationship with Members or Senior Officers of the Council must be disclosed. E5496

MINISTRY OF POWER

PRINCIPAL SCIENTIFIC OFFICER

Pensionable post at Safety in Mines Research Establishment, Sheffield, for man with, normally, First or Second Class Honours Degree in Mechanical Engineering or equivalent qualification. Knowledge of mechanical engineering as applied to modern mining methods, particularly winding, haulage and roof control, and of physics and metallurgy, is necessary. Salary scale £1460–£2070. Starting pay may be above minimum. Promotion prospects.—Write, Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S4973/59. Closing date 21st May, 1959. E5596

BOROUGH OF EALING

ENGINEER FOREMAN

ENGINEER FOREMAN, Misc. VI (£715–£775 inclusive).

Skilled engineering fitter, experienced in steam and oil-fired boilers, automatic stokers, kitchen machinery and machine tool repairs.—Full particulars and application form from Borough Surveyor, Town Hall, Ealing, W.5. Closing date 11th May, 1959. E5594

PUBLIC APPOINTMENTS

CENTRAL ELECTRICITY GENERATING BOARD

RESEARCH LABORATORIES, LEATHERHEAD, SURREY

ENGINEERS and PHYSICISTS — Ref. ENR/137

required in the Generation Section for work on heat transfer problems associated with the fuel elements for nuclear power stations. This work is principally carried out on large test rigs, but, in addition, investigations would be made into the temperature drop at the interface between the fuel and its protective sheath.

Applicants should have an Honours Degree and previous research experience is desirable. Salaries on scales within the ranges £1195–£1775, or £570–£1300 p.a., according to duties and responsibilities.

ENGINEERS — Ref. ENR/136

required in the Mechanical and Civil Engineering Section for work on problems associated with overhead line towers, conductors and their associated fittings.

Candidates should possess a good theoretical background in mechanical engineering and be able to formulate and carry through their own research programme using both the theoretical and experimental approach.

A Degree or H.N.C. in Mechanical Engineering is the minimum qualification required, with preferably some industrial research experience.

Salaries on scales within the range £570–£1300 p.a., according to duties and responsibilities.

Application forms obtainable from, and returnable to, the Personnel Officer, 24/30, Holborn, London, E.C.1, by 11th May.

Please mark envelopes " Confidential," quoting relevant reference number. E5561

TENDERS

COMMISSIONERS FOR THE PORT OF CALCUTTA

CHIEF ENGINEER'S DEPARTMENT

TENDER NOTICE FOR NEW WHARF CRANES

TENDERS in prescribed form are invited for the SUPPLY, DELIVERY C.I.F. Calcutta, ERECTION and TESTING of 71 ELECTRIC CRANES, noted below :—

51 (Nos.) 3-ton Electric Portal Cranes.
17 (Nos.) 5-ton Electric Portal Cranes.
1 (No.) 25-ton Electric Portal Crane.
2 (Nos.) 3-ton Diesel Electric Cranes.

With all necessary parts, fittings, appliances and materials, &c.

Tender documents with specification and drawings containing full particulars of the work, can be obtained from either the undersigned on production of a Cash Receipt of Rs.100 (One Hundred Rupees), or £8 (Eight Pounds) per set, which sum has to be deposited with the Commissioners' Chief Accountant and Financial Adviser or from the Commissioners' Consulting Engineers, Messrs. Rendel, Palmer and Tritton, London, on payment of £8 per set.

The intending Tenderer will have to deposit with the Commissioners' Chief Accountant and Financial Adviser, at 15, Strand Road, Calcutta-1, India, a sum of Rs.20,000 (Twenty Thousand Rupees), or with Messrs. Coutts and Company, 440, Strand, London, England, the sum of £1500 (One Thousand Five Hundred Pounds), to the credit of the Commissioners as Earnest Money before the submission of the Tender and attach the receipt to the Tender. The amount of Earnest Money will be refunded to unsuccessful Tenderers, and in the case of successful Tenderers, this amount will be adjusted towards the security deposit.

Tenders are to be submitted, in triplicate, in sealed cover, superscribed " Tender for the Supply of 71 (Nos.) New Electric Cranes for Calcutta Port," one copy to be sent to Messrs. Rendel, Palmer and Tritton, 125, Victoria Street, Westminster, London, S.W.1, England, and two copies to the Chief Engineer, Calcutta Port Commissioners, 15, Strand Road, Calcutta-1, India, so as to reach them by 11.00 hours British Summer Time, in London, or by 16.00 hours Indian Standard Time, in Calcutta, on July 27th, 1959. After this time and date, no Tender will be accepted.

Tenders will be opened shortly after the specified time on the same date and any Tenderer who wishes to be present at the time of opening may do so.

The Commissioners do not bind themselves to accept the lowest or any Tender and reserve the right to accept the Tender in part or as a whole and not to assign any reasons for the same.

T. M. MALKANI, M.I.C.E.,
Chief Engineer,
For the Commissioners for the Port of Calcutta. E5545

COUNTY OF NORTHUMBERLAND

SUPPLY OF NEW HIGHWAY PLANT

The above Council invite TENDERS for the supply of the following items of new highway plant :

6 No. SMALL COMPRESSORS, 75 cu. ft. min. capacity.
3 No. FOOTPATH ROLLERS, 3–3½-ton, 3 roll Diesel type.
2 No. ROLLERS, 8–10-ton, 3 roll Diesel type.
5 No. 5–6-ton DIESEL WAGONS.
5 No. 3–4-ton DIESEL WAGONS.
12 No. INDUSTRIAL TYPE TRACTORS with high lift shovel attachment.
12 No. Hydraulic End TIPPING TRAILERS.
12 No. SETS of SCRAPER BRUSHES, including spares for tractor mounting.
12 No. VERGE EDGING TOOLS, " Somerset " type.
12 No. TRACTOR, mid-mounted grass cutters.
10 No. Small Diesel DUMPERS.
1 No. ¾ cu. yd. EXCAVATOR.
1 No. COMPRESSOR, 130 cu. ft. min. capacity.
2 No. 4in. diameter DIESEL PUMPS.
1 No. TRACTOR SHOVEL with auxiliary equipment.

Specifications may be obtained from the County Surveyor, Phoenix House, Queen Street, Newcastle upon Tyne, 1.

Tenders in a plain sealed envelope addressed to the Clerk of the County Council, County Hall, Newcastle upon Tyne, 1, should be delivered not later than the 9th May, 1959.

E. P. HARVEY,
E5538 Clerk of the County Council.

TENDERS

MERE AND TISBURY RURAL DISTRICT COUNCIL

COMPREHENSIVE SCHEME OF WATER SUPPLY—PART V : WITHIN TWENTY-ONE PARISHES OF THE DISTRICT

The Council invite TENDERS from experienced Civil Engineering Contractors for the CONSTRUCTION of TWO SMALL RESERVOIRS and the PROVISION and LAYING of approximately 36 MILES OF WATER MAINS and BRANCHES as under :

(1) 1000 yds. 6in. spun iron pipe.
(2) 13,300 yds. 4in. spun iron pipe.
(3) 31,100 yds. 3in. spun iron pipe.
(4) 4900 yds. 6in. asbestos cement pressure pipe.
(5) 2200 yds. 4in. asbestos cement pressure pipe.
(6) 11,000 yds. 3in. asbestos cement pressure pipe.
(7) Teffont reservoir of 65,000 gallon capacity.
(8) Sutton Mandeville reservoir of 20,000 gallon capacity.
(9) Valves, fittings and appurtenant works.

Contractors desirous of Tendering are requested to advise the Council's Consulting Engineers, Messrs. T. WARD WHITFIELD & SON, 54, Stallard Street, Trowbridge, Wilts., not later than 30th April, 1959, after which they will receive full particulars. The applications must be accompanied by a deposit of five guineas, which will be returned after receipt of a bona fide Tender.

Tenders in plain, sealed envelopes endorsed " Tender for Waterworks," must reach the undersigned by a date to be given by the Engineers.

The Council do not bind themselves to accept the lowest or any Tender.

M. E. BARRETT,
Clerk of the Council.
Council Offices,
Mere,
Wilts. E5454

INDIA STORE DEPARTMENT

MILD STEEL SHEETS

The Director General of India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of :—

	Quantity Tons
MILD STEEL SHEETS, extra deep drawing quality, 48in. by 20ft.in. by 20 B.G.	1370

Forms of Tender may be obtained from the above address on or after the 24th April, 1959, at a fee of 10s., which is not returnable. If payment is made by cheque, it should please be made payable to " High Commission of India." Tenderers must send their Tenders so as to reach this office latest by 1 p.m., Monday, 1st June, 1959.

Please quote Reference No. 47/58/RLY. E5577

INDIA SUPPLY MISSION

The office of the India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington, D.C., United States of America, invites TENDERS for the following :—

TENDER ENQUIRY No. SE.40.

For the SUPPLY of 66kV CONTROL PANELS, 11kV SWITCHBOARDS, BATTERY CHARGING SETS required, for Bhadra Generating Station.

Specifications, &c., regarding the above enquiry, can be obtained direct from the Co-ordination Branch, India Store Department, Government Buildings, Bromyard Avenue, Acton, W.3, at £1 15s. 9d. per Tender. Tenders are to be returned direct to India Supply Mission, 2536 Massachusetts Avenue, N.W. Washington, D.C., United States of America, so as to reach them by 14th May, 1959.

Specimen copy of the above specification can be seen at India Store Department, Government Buildings, Bromyard Avenue, Acton, W.3, under reference S.4343/58/NSC/ENG.2. E5578

TENDERS

MADRAS PORT TRUST

The Office of the Madras Port Trust, Madras, India, invites TENDERS for the following :

(a) TENDER ENQUIRY No. 16/E.P.3/26657/59. For the SUPPLY of 3 (Nos.) 9in. CENTRE LATHES.

(b) TENDER ENQUIRY No. 16/E.P.3/26437/59. For the SUPPLY of 3 (Nos.) 6in. CENTRE LATHES.

(c) TENDER ENQUIRY No. 16/E.P.3(m)/26961/59. For the SUPPLY of ONE ELECTRIC MOTOR DRIVEN CAPSTAN LATHE.

(d) TENDER ENQUIRY No. 16/E.P.3/25483/59. For the SUPPLY of ONE MOTOR DRIVEN HEAVY DUTY 12in. PRECISION LATHE.

(e) TENDER ENQUIRY No. 16/E.P.3(m)/26960/59. For the SUPPLY of 2 (Nos.) ELECTRIC MOTOR DRIVEN 14in. HEAVY DUTY LATHES.

Specifications, drawings, &c., relative to the above Tender enquiries can be obtained direct from the Deputy Chief Accounts Officer (Engineering), Chief Engineer's Office, Madras Port Trust, Madras 1, India, on payment of : (a) £1 2s. 6d. per Tender set ; (b) 4s. 6d. per Tender set ; (c) 6s. per Tender set ; (d) 10s. 6d. per Tender set ; (e) 15s. per Tender set.

Tenders are to be returned direct to the Chief Engineer ("C" Warehouse), Madras, Port Trust, Madras, India, so as to reach him by : (a) 22nd June, 1959 ; (b) 29th June, 1959 ; (c) 3rd July, 1959 ; (d) 15th June, 1959 ; (e) 8th July, 1959.

Specimen copy of the above enquiries can be seen at India Store Department, Government Buildings, Bromyard Avenue, Acton, W.3, under the following references :

(a) S3007/59/NSC/ENG.2.
(b) S3004/59/NSC/ENG.2.
(c) S3006/59/NSC/ENG.2.
(d) S3008/59/NSC/ENG.2.
(e) S3005/59/NSC/ENG.2. E5579

EDUCATIONAL

WORCESTERSHIRE EDUCATION COMMITTEE

COLLEGE OF FURTHER EDUCATION

BROMSGROVE, WORCESTERSHIRE

SESSION 1959-60

Applications for entry to the following Sandwich Courses are invited from Students with appropriate qualifications :

(1) HIGHER NATIONAL DIPLOMA IN MECHANICAL AND PRODUCTION ENGINEERING.

Six months College/6 months Industry (Works-based and College-based). Length of Course 3 to 4 years according to entry qualifications.

Commencing : January, 1960.

(2) AUTOMOBILE ENGINEERING, LEADING TO THE ASSOCIATESHIP OF THE INSTITUTE OF THE MOTOR INDUSTRY. (TECHNICAL AND COMMERCIAL.)

Six months College/6 months Industry (Works-based and College-based). Length of Course 3 years.

Commencing : November, 1959.

(3) INSTITUTE OF COST AND WORKS ACCOUNTANCY.

Three months College/3 months Industry. Length of Course 2/3 years according to entry qualifications. (Direct entry to final stage can be arranged for suitably qualified Candidates).

Commencing : September, 1959 and March, 1960.

Pamphlets giving full details of course content and administrative arrangements are available from :

The Registrarar,
College of Further Education,
Alcester Road,
Bromsgrove,
Worcestershire. (N.201) E5543 E

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent. successes. 148-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London W.8. E114 E

EDUCATIONAL

IMPERIAL COLLEGE

BURSARIES IN STRUCTURAL STEELWORK

Bursaries provided by the British Steel Producers Conference and the British Constructional Steelwork Association are available for the new post-graduate course in Structural Steelwork dealing with the application of modern analytical and design methods to practical design problems.

The value of the bursaries is from £475 to £775 from which fees (£64) will be payable, for the period from October, 1959 to July, 1960. Applicants must have a good first Degree in Civil Engineering or equivalent qualification and preferably some practical experience in structural steelwork design. Applications including the names of two referees should be made by June 30th, 1959, to : The Registrar, Imperial College, London, S.W.7, from whom further particulars may be obtained.

E5532 E

UNIVERSITY OF LONDON : Professor B. D. H. Tellegen (Philips Research Laboratories, Eindhoven) will deliver a lecture "The Gyrator as a Network Element" at 5.30 p.m. on 29th April at King's College, Strand, W.C.2, and a lecture "The Search for a Complete Set of Ideal Non-linear Network Elements" at 5.30 p.m. on 30th April at Imperial College of Science and Technology, City and Guilds College (Room O4), Exhibition Road, S.W.7.

ADMISSION FREE, WITHOUT TICKET
JAMES HENDERSON,
Academic Registrar.
E5522 E

AUTOMATION.—AUTHORITATIVE COURSES are now available in Digital and Analogue Computer Technology, Applied Electronics, Data Processing and Instrumentation up to professional level by home study. Individual enrolment or industrial group scheme enrolments accepted. Syllabuses and prospectus sent on request.—Write (Dept. S.E.8), E.M.I. Institute School of Electronics, College House, Kensington, London, W.8. E145 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

A.E.I.-HOTPOINT, LTD.

As part of our expansion programme applications are invited for the following attractive openings in the Domestic Appliance Design Team at our factory in Peterborough, Northants.

JUNIOR ENGINEER FOR HOME LAUNDRY

age 21/26. Must possess at least Higher National Certificate, Mechanical Engineering, and have served an indentured apprenticeship in general engineering. Some experience in mechanical engineering on quantity production would be an advantage.

JUNIOR HEATING ENGINEER

with Higher National Certificate or equivalent in Electrical Engineering, preferably with works apprenticeship and/or drawing-office experience on development and design of domestic heating appliances and equipment.

The Company is interested in employing outstanding men and is prepared to pay appropriate salaries.

General working conditions are good and a pension scheme is in operation. Assistance with housing will be given in appropriate cases.

Applications, giving full particulars of personal history and experience, should be addressed to the :

Employment Officer,
A.E.I.-HOTPOINT, LTD.,
33, Grosvenor Place, London, S.W.1.

E5551 A

BOOKS and PUBLICATIONS

PITMAN | *TECHNICAL BOOKS*

HIGHER ELECTRICAL ENGINEERING
By J. Shepherd, B.Sc., etc., A. H. Morton, B.Sc., etc., and L. F. Spence, B.Sc., etc. Here is the first book to attempt to cover the whole course for the A.1. and A.2. years of the Higher National Certificate in Electrical Engineering in a single volume. The MKS system has been used throughout. 40s. net.

A STUDENT'S INTRODUCTION TO SEWAGE WORKS DESIGN
By T. C. H. Bateson, A.M.I.C.E., etc. This book gives the engineering student a broad picture of the essential principles underlying the design of sewage works and describes the best examples of the use of the various machines and appliances now available. 27s. 6d. net.

FINITE DIFFERENCE EQUATIONS
By H. Levy, D.Sc., etc., and F. Lessman, Ph.D., etc. Nowadays a detailed examination and mastery of the Finite Difference Equation is of the utmost importance to final-year and graduate mathematicians, mathematical physicists and engineers, and actuarial students and actuaries. This new book presents a treatment of such equations and their general method of solution. 37s. 6d. net.

From all booksellers | *Parker St., Kingsway, London, W.C.2*

SITUATIONS VACANT

A PROGRESSIVE ENGINEERING COMPANY in the Victoria area of London requires a DRAUGHTSMAN for a responsible post in small Drawing-Office. This post offers good prospects and an attractive salary to a man with general engineering experience. Five-day week and pension scheme in operation.—Please send details of experience to The Chief Draughtsman, THE WELLMAN BIBBY CO., LTD. ARTILLERY HOUSE, ARTILLERY ROW, LONDON, S.W.1. E5539 A

AIR-CONDITIONING AND REFRIGERATION SERVICE AND TEST ENGINEER required by London Office of large air-conditioning company to supervise installation, regulation and testing all types air-conditioning, cooling, treatment installations, required to travel all parts of country and abroad. Pension scheme and bonus.—Write BOX E, 128, LPE, Romano House, 399/401, Strand, London, W.C.2. E5580 A

ASSISTANT TECHNICAL ENGINEER (ELECTRICAL) required for iron and steel works, age 25–35. Broad practical training and experience in heavy industry desirable, with H.N.C. as minimum technical qualification.—Applications to Works Manager, GUEST KEEN IRON AND STEEL CO., LTD., East Moors, Cardiff. E5562 A

CHIEF DRAUGHTSMAN WANTED for Crane Works manufacturing wide range of heavy Steelworks and Dockside Cranes ; good salary ; pension scheme. State age, experience and salary expected.—BOX No. E5451, "The Engineer." A

COMPRESSOR DESIGNER

A vacancy occurs in an old-established company in the Midlands for a first-class Engineer with experience in design of air and gas compressors. Applications are invited from men with at least five years' experience in the design of such machines and who hold at least Higher National Certificate in Mechanical Engineering. The successful applicant will be required to devote a fair proportion of his time to new development work requiring a high degree of initiative and personal design responsibility and a good salary will be paid to a first-class man. Please send full particulars to the Technical Director.—BOX No. E5421, "The Engineer." A

CONSULTING ENGINEERS require SENIOR and JUNIOR DRAUGHTSMEN, experienced in any of the following :—Pipework and pressure vessels, layout of electrical services, heating and ventilating.—MILLS AND BRAIN, LIMITED, 207, Lewisham High Street, London, S.E.13. (Lee Green 8019). E2366 A

DESIGN DRAUGHTSMAN required for mechanical design of nucleonic instruments. Pleasant working conditions. Excellent rates of pay.—Apply Chief Draughtsman, ISOTOPE DEVELOPMENTS, LTD., Beenham Grange, Aldermaston, Berks. Tel.: Woolhampton 451. E152 A

DESIGN ENGINEER

required for the investigation, carrying-out of preliminary trials, and the setting-up of production of Mineral Insulated Cables.

Applicant should have both theoretical and practical experience ; age 28 to 40 years old.

Apply :
The Manager,
GLYNWED PLANT, LTD.,
Bilston, Staffs.

E5474 A

DESIGNER/DEVELOPMENT ENGINEER required for work on domestic appliances. Applicants, aged 25–40, should have served an engineering apprenticeship, and have had experience in drawing-office and/or model shop work. Must be capable of working on their own initiative, able to produce drawings and to supervise the manufacture of prototype models. Electrical knowledge would be an advantage. Salary according to age and experience. Pensionable post.—Applications in writing only, stating full particulars of previous experience, age and present salary, to Personnel Officer, KENWOOD MANUFACTURING CO., LTD., Old Woking, Surrey. E2367 A

DESIGN/DRAUGHTSMEN

Applications are invited from men under 40 years of age who were apprentice-trained and hold H.N.C. or equivalent, to fill vacancies in the following D.O. Sections :—

1. MECHANICAL.—Experience required in general mechanical design and installation, preferably of medium to heavy industrial process plant.
2. ELECTRICAL.—Good all-round experience desired in the installation of the electrical plant and services of a large factory.
3. WORKS SERVICES (Steam, Water and Air). —For this good experience of problems involving industrial steam applications, piping and pumping systems is essential, and an H.N.C. endorsement for Heat Engines, Applied Thermodynamics or Steam Engineering is desirable.

All appointments are permanent and pensionable ; 5-day, 40-hour week ; 3 weeks' annual holiday ; good working conditions. Assistance with housing given when necessary and pending removal a tax-free allowance of £4 per week is given to married men. Company pays cost removal.

Please write to SP.A Dept., MICHELIN TYRE CO., LTD., STOKE-ON-TRENT, STAFFS, quoting ref. B2/E.

E5546 A

DESIGN ENGINEERS AND SENIOR DRAUGHTSMEN required for North London firm of mechanical engineers. Experience in mechanical handling and/or bottling plant an advantage. Initial salary not less than £1000 p.a. for first-class men of initiative and responsibility. Canteen facilities. Pension scheme. Apply with full particulars.—BOX No. E5468, "The Engineer." A

DESIGNER-DRAUGHTSMAN, experienced in Heavy Oil Engines, Marine experience an advantage. Qualifications : H.N.C. and practical background. Age group 25–30 years, required by small firm building Marine Oil Engines, in powers up to 1600 H.P. Salary £800 to £950, according to qualifications. Non-contributory pension scheme, house available for married man.—Apply, with full particulars, to THE NEWBURY DIESEL CO., LIMITED, NEWBURY, Berks. E5402 A

DESIGNER - DRAUGHTSMAN (MECHANICAL) required for Research and Development Team engaged on interesting development work in connection with special structures and diesel and steam operated plant. Minimum qualifications H.N.C. Age group 24–30 years. The appointment is permanent and progressive in an expanding organisation. Contributory Pension Scheme and good canteen facilities. Holiday arrangements respected. Salary in accordance with age, qualifications and experience. The works are situated 15 (fifteen) minutes 'bus journey from the centre of Ipswich.—Applications to the Personnel Officer, THE BRITISH STEEL PILING COMPANY, LTD., Claydon, Suffolk. E5477 A

DEVELOPMENT ENGINEER for original development work on new manufacturing processes and new products, required by internationally known light engineering company situated in the East Midlands. The ideal applicant should have a good Engineering Degree, but applicants with H.N.C. in Mechanical or Production Engineering and some Electrical Engineering knowledge will be considered if they have the essential interest in and ability to carry out original engineering development work. Applicants should have served a recognised engineering apprenticeship and have had some experience of production problems in light engineering industry. Life assurance, pension scheme, sickness benefit and generous holidays, together with a good starting salary and excellent prospects of promotion, are available for the right man.—Apply, giving details of age, experience, qualifications and salary requirements, to BOX No. E5548, "The Engineer." A

DRAUGHTSMAN.—A vacancy has occurred for a young man—versatile—as Engineering Draughtsman in a plastics manufacturing company. General experience required—Higher National Certificate desirable. A.E.S.D. rates and above. The conditions of work are good, and a pension scheme is in operation. The factory is situated in pleasant country between Ipswich and Colchester, and within easy reach of the Essex and Suffolk coasts. Transport facilities are available from Ipswich, Colchester, Harwich and Clacton areas.—Application should be made in writing to the Personnel Manager at BX Plastics, Ltd., Brantham Works, Nr. Manningtree, Essex, stating age, qualifications and experience, and career to date. E5544 A

DRAUGHTSMEN

required, with experience in

SHELL-TYPE BOILER DESIGN

OR

PRESSURE VESSEL DESIGN

Applications, which will be treated in confidence, must give full details of past experience and qualifications.

Address to : The Secretary,
COCHRAN AND CO., ANNAN, LTD.,
Annan, Dumfriesshire.

E5591 A

ELECTRICAL DESIGN ENGINEER

Bruce Peebles and Co., Limited, East Pilton Edinburgh, 5, require a Designer experienced in the design of medium and large D.C. machines. Salary commensurate with experience. Production bonus, superannuation scheme, removal expenses and assistance with housing if necessary. —Applications, stating details of education, training, experience and age, to the Chief Engineer at the above address. E5589 A

ELECTRICAL ENGINEER—INDIA

Electrical Engineer required for long-established Metalliferous Mine in India.

Corporate Membership of I.E.E. essential. Generous salary and allowances in keeping with experience. Excellent amenities golf, tennis, swimming, &c. Three-year tour normally includes five months' leave on full pay.

Write in first place with full particulars birth, nationality, training and experience, &c., BOX AP/127, c/o 95, Bishopsgate, E.C.2.

E5592 A

ELECTRICAL SALES ENGINEERS

Bruce Peebles and Co., Limited, East Pilton, Edinburgh, 5, require Engineers of H.N.C. standard for their Transformer Sales and Contracts Department ; 5-day week. Staff pension and bonus schemes. Housing assistance given if necessary.—Apply, giving details of experience, to Divisional Director (Transformers), at the above address. E5588 A

EXCELLENT OPPORTUNITY EXISTS for WORKS TRAINED ENGINEER having sound technical qualifications. Age 28–35 years, of good appearance, pleasant personality. Duties initially selling machinery to Mining Companies, National Coal Board and Quarries. Remuneration salary or salary and commission, car provided, ultimate objective sales control and Board within ten years. Contributory Pension Scheme.—Write full particulars experience to Managing Director, PEGSON, LTD. Coalville, Leicestershire. E5452 A

Classified Advts. continued on page 122

SITUATIONS VACANT

ENGINEERING STAFF

required by the United Kingdom Atomic Energy Authority in the Research and Development Laboratories, Windscale, Sellafield, Seascale, Cumberland for the following posts :

(a) PLANT MANAGEMENT ENGINEER (Ref. 3052/J.1)—to be responsible, in a section engaged in research on irradiated components and materials, for a small team operating a specialised remote handling plant in which irradiated components are dismantled, tested, and cut for laboratory examination.
The ability to introduce new design features and techniques will be required.

(b) WORKSHOP ENGINEER (Ref. 3053/J.1)—to be responsible for co-ordinating the engineering requirements of the laboratories. Duties include the overall control of machine, sheet metal and welding workshops, and of work carried out by contractors and by departments of Windscale Works to supplement the facilities of the laboratories.

(c) DESIGN ENGINEER (Ref. 3054/J.1)—to take charge of a small office engaged on the design of experimental rigs and plant. The work is essentially mechanical in nature, but some knowledge of electrical, instruments, chemical and civil engineering will be required.
Salary between £1345 and £1800 according to qualifications and experience.

(d) PROJECT ENGINEER (Ref. 3055/J.1)—to be responsible for planning, progressing and commissioning of small scale experimental plant and for close liaison with scientific and engineering staff during the design, manufacturing and construction stages.
Experience in mechanical and chemical engineering fields would be an advantage.
Salary between £845 (at age 25) and £1315.

Applicants must have served a recognised engineering apprenticeship and be corporate members of a senior engineering institution, or equivalent. Considerable experience in appropriate fields is essential for posts (a) to (c). The ability to work closely with scientific staff on experimental projects is required for all posts.
Contributory Superannuation. Staff housing scheme.
Send postcard for application form, quoting appropriate reference to Recruitment Officer, U.K.A.E.A., I.G.H.Q., Risley, Warrington, Lancashire.
Closing Date : 11th May, 1959.

E5524 A

ENGINEERS FOR MIDDLE EAST

(a) QUALIFIED ENGINEERS with 10 years' experience design and construction pipeline, pump stations and tank farms, for Middle East.

(b) QUALIFIED HYDRAULIC ENGINEERS with 5 years' experience design pipeline system, for Middle East.

(c) MECHANICAL ENGINEERS with extensive experience pipeline, pump stations and tank farms construction, for Middle East.
Submit curriculum vitae stating whether for (a), (b) or (c) to BOX No. 2473, c/o Charles Barker and Sons, Ltd., Gateway House, London, E.C.4.

E5498 A

FOREMAN REQUIRED for the factory maintenance department of a large plant manufacturer in the London area. Applicants must be capable of organising the work of a staff of forty tradesmen and have good knowledge and experience of oil-fired boilers and the usual factory services—Particulars of training, experience, present salary and age, to BOX No. E5542, " The Engineer." A

GENERAL MANAGER REQUIRED, to take complete charge of small engineering works. Administrative experience essential. Salary according to ability and qualifications.—BOX No. E2369, " The Engineer." A

GEORGE WIMPEY AND CO., LIMITED

invite applications for the following appointments in Head Office,

ENGINEERS for preplanning work. Applicants should have good site experience on either multi-storey building or civil engineering contracts and knowledge of modern plant and methods.

FORMWORK DRAUGHTSMAN for design of formwork for multi-storey building contracts.

Five-day week, 9.0 to 5.30, staff restaurant.

Applications, giving details of age and experience, to :

Establishment Officer,
27, Hammersmith Grove, London, W.6.
Ref. 676 C.

E5596 A

LEADING FIRM OF BULK MATERIALS HANDLING ENGINEERS, located in North East England, require experienced SECTION LEADER and SENIOR DRAUGHTSMEN for design and detail work on all types of conveying equipment and allied structure. Excellent salary offered, pension scheme in operation. Canteen facilities available.—BOX No. E2364, " The Engineer." A

JUNIOR SALES ENGINEER required by Yorkshire manufacturer of heavy industrial gears. Must be technically trained at least up to H.N.C. standard. Excellent opportunity for a man with drive, initiative and the right experience. Write, with full details of past career and required salary.—BOX No. E5427, " The Engineer." A

MECHANICAL ENGINEER

required for N.C.B.'s Coal Research Establishment, Stoke Orchard, Nr. Cheltenham, Glos, to lead a research group responsible for design, development and installation of mechanical and hydraulic machinery for use in the coal industry. A wide general experience of mechanical engineering, toegther with a good Honours Degree (or equivalent) in that subject is required. Appointment superannuable ; salary and grade according to qualifications and experience within £1375–£2150.—Write, with full particulars of age, education, qualifications and experience, to Staff Department (X.1342/3E.), National Coal Board, Hobart House, London, S.W.1, before 8th May, 1959.

E5593 A

MECHANICAL ENGINEER

COURTAULDS, LIMITED, Chemicals Division, requires a Graduate (or qualified) MECHANICAL ENGINEER for its large chemical manufacturing plant near Manchester. In addition to the day to day manufacture of heavy chemicals (which offers a great variety of work) there is also scope for investigational and development work on the design of new plant and on the maintenance side of works engineering. In short, the work combines traditional workshop practice with an original approach to new problems and requires an absence of professional prejudice. It also provides opportunities for a man to follow his own work through to the final fruition of commissioning and operation. Previous industrial experience is desirable but a new graduate would be considered if he has had practical vacation experience. The post is pensionable and the occupant will be eligible for the Company's Co-partnership Scheme.
Candidates should write for a detailed form of application to the Director of Personnel, Courtauids, Ltd., 16, St. Martin's-le-Grand, London, E.C.1, quoting reference number H.13.

E5480 A

PEERLESS AND ERICSSON,

FACTORY CENTRE, KINGS NORTON, BIRMINGHAM, 30

JIG AND TOOL DRAUGHTSMAN required immediately for the design of tools for machinery necessary in the food preparation industry and general engineering. Used to mass and batch production methods.—Full details of experience, salary, &c., to the General Works Manager.

E5534 A

PEERLESS AND ERICSSON,

FACTORY CENTRE, KINGS NORTON, BIRMINGHAM, 30

PROJECT DESIGNER ENGINEER required immediately, preferred with experience in the dseign of food preparation machinery, including electrical, but not essential. Applicants should possess at least H.N.C., have had practical training, and should be able to work with minimum of supervision, also, if necessary, help Development Department with prototypes. —Full details of experience, salary, &c., to the General Works Manager.

E5535 A

SALES ENGINEER
SOUTHAMPTON AREA
DAVID BROWN INDUSTRIES, LIMITED,
INDUSTRIAL GEAR DIVISIONS

A vacancy arises for a SALES ENGINEER, to represent the Industrial Gear Divisions in an area approximately 60 miles radius of Southampton.
Previous engineering sales experience and a sound background in mechanical power transmission is essential.
The successful applicant will be required to reside in and have a good knowledge of the area to be covered. Good salary, three weeks' annual holiday. Good superannuation scheme, free life assurance. Company car provided.
Applications, giving full details of education, experience and an indication of salary expected, should be addressed in confidence to :

The Chief Personnel Superintendent,
David Brown Industries, Limited,
Park Works,
Huddersfield.

E5540 A

REQUIRED BY A LARGE GROUP OF COMPANIES situated on the South Coast. DRAUGHTSMAN, experienced in general civil engineering and pipe work for fuel oil installations. Write, giving full details of age, experience, salary required, &c.—Contributory pension scheme in operation.—BOX No. E2358, " The Engineer." A

SALES ENGINEER

required by progressive and expanding engineering company in South West London manufacturing capital plant and machinery sold throughout the world for a basic industry. Previous sales experience unnecessary, but good general education and sound engineering training essential with H.N.C. or preferably Degree. Student apprenticeship with large firm an advantage. Knowledge of German an advantage, but not essential. Permanent position with excellent opportunities for advancement. Contributory pension scheme. Starting salary up to £1000, depending on qualifications, but we want a good young engineer with a bent for technical sales who will be worth much more to us when he has learned his work.

BOX No. E5537, " The Engineer."

A

SALES ENGINEER required (London, E.C.3). Only those with sound technical background need apply. Experience in any one of the following advantageous :—Pressure vessels, electric cranes, machine tools or plateworking machinery. This is a post with excellent prospects for the right man.—Fullest details of age, experience and salary to BOX No. E5595, " The Engineer." A

SENIOR DESIGN DRAUGHTSMAN required for interesting work on mechanical engineering projects. Knowledge of hydraulics an advantage.—CHAMBERLAIN INDUSTRIES, LTD., Staffa Road, Leyton, E.10 (LEY 3678). E5499 A

SENIOR DESIGN ENGINEER required for development and production design of high-speed centrifugal equipment. Good Degree or equivalent qualification. Experience of high-speed machinery desirable. Age 28–36. A practical and enthusiastic attitude to commercial engineering essential.—Write, in confidence, giving full details, to The Managing Director, SHARPLES CENTRIFUGES, LIMITED, Tower Works, Doman Road, Camberley, Surrey. E5385 A

SENIOR ELECTRICAL ENGINEER required for drawing-office work on design, production and installation of service, industrial and nuclear projects. Experience on medium and low-power installations, servo control systems and equipment, instrumentation is essential. Salary commensurate with qualifications and experience.—Apply in writing, stating age, qualifications and experience, to : " S.E.E.," VICKERS-ARMSTRONGS (ENGINEERS), LTD., Barrow-in-Furness. E5541 A

SENIOR STRUCTURAL STEELWORK DESIGNER/DRAUGHTSMAN (TWO), with several years' varied experience, age 30–40, one of above with Estimating Office experience.—Write to THE SECRETARY, Richards Structural Steel Company, Ltd., Phoenix Iron Works, Leicester. E2363 A

TECHNICAL EDITOR REQUIRED by rapidly expanding organisation in the East Midlands. This appointment carries an excellent starting salary and offers considerable scope for development to a man with ability, energy and a wide knowledge of production and mechanical engineering. Excellent superannuation scheme and pleasant surroundings. Send details of career and present salary.—BOX No. E5446, " The Engineer." A

THE MAKERS OF HOLLANDS TOFFEE require a DRAUGHTSMAN (MECHANICAL), age 25–40. Qualifications must include apprenticeship and preferably H.N.C. Workshop experience desirable, coupled with knowledge of machine design and mechanical handling. Experience of confectionery machinery manufacture an advantage. Salary according to qualifications and experience. Non-contributory pension scheme.—Full details in own handwriting to Personnel Manager, Arthur Holland, Southport. E5549 A

THE POWER-GAS CORPORATION, LIMITED, have vacancies in their Petroleum Plant Division Drawing-Office at West Ealing, London, W.13, and invite applications from men having experience in the petroleum industry, particularly plant layout pipework and pressure vessel design. Salary offered will be commensurate with qualifications and experience. Good working and holiday conditions, staff pension scheme in operation.—Apply in writing, giving full information of experience and technical qualifications, to : The Divisional Manager, The Power-Gas Corporation, Ltd., Petroleum Plant Division, 105–113, The Broadway, West Ealing, London, W.13. E5536 A

TRANSLATORS REQUIRED for translation of technical periodicals, books, &c., from and into Russian. Sound knowledge of mechanical or production engineering essential. These are key positions in a rapidly expanding organisation in the East Midlands, with excellent prospects of advancement, working conditions and superannuation scheme.—Send full details to the Secretary, PRODUCTION ENGINEERING RESEARCH ASSOCIATION, Melton Mowbray, Leics. E5445 A

WALKER BROTHERS (WIGAN), LTD.—a progressive firm engaged in the manufacture of paper and board-making machinery have vacancies for EXPERIENCED MECHANICAL ENGINEERING DRAUGHTSMEN—preferably with H.N.C. Superannuation fund, canteen and welfare facilities.—Applications, stating age, experience, &c., to the Personnel Manager, Pagefield Iron Works, Wigan. E5137 A

WELL-KNOWN EAST YORKSHIRE ENGINEERING COMPANY REQUIRES TECHNICAL REPRESENTATIVE to promote sales of medium/heavy chemical engineering plant. The post offers good prospects to man able to bring results.—Applications, which will be treated in strict confidence, stating details of age, experience, &c., and suggestions as regards remuneration, to BOX No. E5547, " The Engineer." A

NORTH BRITISH RUBBER AND U.S. RUBBER OF AMERICA

continuing the expansion of their production facilities at Castle Mills, Edinburgh, require a qualified Engineer for the Industrial Engineering Division. Candidates, aged 27–40, should have good design experience, particularly with reference to jigs, tools and mechanisms, and must have the initiative and energy to follow through to a successful conclusion the transformation of basic ideas into improved production facilities. A flair for this kind of work is more important than technical qualifications but a Degree or Corporate Membership of an Engineering Institution would be an advantage. An attractive salary will be offered to the successful candidate, and Company benefits include a contributory superannuation scheme and free Life Assurance. The Company are also prepared to assist with removal expenses. Applications, marked E, giving full details of qualifications, experience and age, should be addressed to Industrial Relations Division, The North British Rubber Co., Ltd., P.O. Box 47, Castle Mills, Edinburgh, 3. E5503 A

Wm. DOXFORD & SONS (ENGINEERS), LTD.

Sunderland

FABRICATION SUPERINTENDENT

This appointment carries Assistant Works Manager status in the marine diesel engine works and involves responsibility for the control of fabricating shops, modernisation of methods and equipment, and liaison with the Technical Department on the design of fabricated structures. The range of work is wide and the post is an interesting one.

Essential qualifications are supervisory experience of fabricating shops in heavy industry, and a sound knowledge of modern methods of fabrication.

Applications, stating age, experience and qualifications should be addressed to the **Personnel Manager.**

E5531 A

SHELL

SHELL CHEMICAL COMPANY LIMITED

require a

SOLIDS HANDLING ENGINEER

for their

LONDON OFFICE

Candidates should be up to 40 years of age with a Degree in Mechanical Engineering and/or the equivalent professional qualification. At least 10 years' experience in the process industries and especially in solids handling is necessary, preferably including the handling of ore, powder and granules, with a knowledge of their transportation, storage, size reduction and blending, as well as drying, colouring and extrusion.
Salary according to qualifications and experience. Attractive pension scheme.
Applications with full details to :

Shell Chemical Company, Limited,
Staff Department/M4,
Clements House,
14/18, Gresham Street,
London, E.C.2.

E5373 A

THE DISTILLERS COMPANY LIMITED

TECHNICAL MANAGER

The Company invites applications for the post of Technical Manager at the Kenfig, Glamorgan, factory of the Chemical Division, where calcium carbide is manufactured. Candidates, aged not over 40, must hold a degree in metallurgy or fuel technology, or an equivalent qualification ; experience of solids handling equipment, rotary kilns or electric furnaces would be an advantage.

The Technical Manager will eventually take charge of a department comprising graduates and technical assistants responsible for the investigation of problems, including short-term development work, arising in the manufacture of calcium carbide.

Write :
STAFF MANAGER,
THE DISTILLERS COMPANY LIMITED,
21, ST. JAMES'S SQUARE,
LONDON, S.W.1.

Quote Ref. 40/59E. E5520 A

SITUATIONS VACANT

PRESSED STEEL COMPANY LIMITED
Railway Carriage & Wagon Division
PAISLEY, SCOTLAND

have some additional appointments for

SENIOR DESIGN ENGINEERS

for work on

RAILWAY ROLLING STOCK, INCLUDING DIESEL AND ELECTRIC MULTIPLE UNITS

The work involved includes structural design, engine and equipment layout, interior trim and styling, and offers considerable scope for advancement. Salary according to age, experience and qualifications. First-class conditions of employment, including Contributory Pension Scheme, &c.—Applications to Personnel Manager.

E5374 A

SITUATIONS VACANT

THE PLESSEY COMPANY LIMITED,
SWINDON, WILTSHIRE

Invite applications for appointment to our Works Engineers' Staff as

PLANT LAYOUT DRAUGHTSMAN

with

Architectural experience

Applicants should have had several years' experience, preferably dealing with light engineering plant.

Please write with details of career, to Employment Officer, The Plessey Co. Ltd., Kembrey St., Swindon.

E5573 A

SITUATIONS VACANT

CENTRAL ELECTRICITY GENERATING BOARD

Applications are invited from suitably qualified ENGINEERS for the post of SECRETARY to the Standardisation Committee, attached to the Purchasing and Contracts Department at Headquarters, London, S.E.1.

Applicants should be interested in standardisation as an aid to stock control and purchasing, and preferably have had experience of the production of standard and/or buying specifications. Some knowledge of purchasing and coding would be an advantage.

Salary scale : £1560–£1760 p.a.

Applications, stating age, qualifications, experience, present position and salary, should be forwarded to the Personnel Officer, 24-30 Holborn, London, E.C.1, by 12th May. Envelopes and applications to be marked " Confidential Ref. ENR./138."

E5587 A

PROJECT ENGINEERS

BRITISH OXYGEN ENGINEERING LIMITED

Applications are invited from qualified and experienced engineers for posts as Project Engineers. These posts entail responsibility for the planning and co-ordination of the design, manufacture and site construction of large-scale chemical plant and other engineering projects.

Previous experience in this field and organising and administrative ability is required.

Excellent salaries and conditions of service are offered and **assistance with house purchase and removal expenses may be given** to successful candidates who will need to move their homes.

Applications should be made in writing, giving full details of experience, qualifications and present salary to :

Employment Officer (E.G. 4545),
British Oxygen Engineering Limited,
Angel Road, Edmonton, N. 18.

E5570 A

Reed

REED CORRUGATED CASES LIMITED

have a vacancy for an

EXPERIENCED GRADUATE MECHANICAL ENGINEER

Applications are invited for a Senior Managerial Appointment as SECTION HEAD in the Packaging Division Development Department. This appointment is tenable at New Hythe, Nr. Maidstone, Kent.

An Engineer possessing proven ability in a wide field of special-purpose and automatic machine tool development and design would be desirable. The successful candidate should be experienced in administration and be aged between 30-40 years.

The salary will be commensurate with the qualifications, experience and high standard required. A non-contributory pension scheme is operated and assistance with house purchase is available, if required.

Applications should be made in writing, stating qualifications, previous experience and present remuneration, and should be addressed to the :

Personnel Manager,
REED CORRUGATED CASES, LTD.,
Great West Road, Brentford, Middlesex,
quoting PDD/ME.

E5569 A

ENGINEERS

Are required to lead or work as Members of teams engaged on Research, Design and Development of mechanical and electro-mechanical equipment of a unique and unorthodox nature.

The work covers a wide field, including laboratory instruments, design of special equipment and acceptance testing of associated equipment. Equipment to be designed entails use of special materials and requires unusual design techniques.

A recognised engineering apprenticeship is required with several years' experience of design work and Corporate Membership of a Senior Engineering Institution.

The appointments are at various levels, depending on ability and experience.
SALARY : Will be assessed within the range £845–£1800.

Contributory Superannuation Scheme. A house or alternatively substantial assistance with house purchase will become available for married officers living beyond daily travelling distance.

POSTCARDS for application forms to the Senior Recruitment Officer at Atomic Weapons Research Establishment, Aldermaston, Berks. Please quote ref. A.2099/25.

E5526 A

PRESSED STEEL COMPANY LIMITED

The Company is engaged in large-scale manufacture of motor-car bodies, commercial, domestic and industrial refrigeration plant, and railway rolling stock, and employs some 19,000 people in plants at Oxford, Swindon, Reading and Paisley. In order to meet a continuously expanding Design, Development and Research programme, applications are invited for senior appointments in the following fields :

JIG & TOOL DESIGNERS

Qualified Jig and Tool Designers with considerable experience in design of press tools for car body manufacture. Location, Oxford and Swindon. (Ref. A.L.A.T.)

PRESS TOOL PLANNERS

Highly skilled Planning Engineers with considerable experience of tooling programmes for flow line manufacture of sheet metal fabrications. Location, Oxford and Swindon. (Ref. A.L.A.T.)

CAR BODY ENGINEERS & DRAUGHTSMEN

Experienced Car Body Engineers and Draughtsmen. Location, Oxford and Swindon. (Ref. H.R.B.)

RESEARCH & DEVELOPMENT ENGINEERS

Research and Development Engineers with knowledge of thermoformed and laminated plastics, mechanical and body engineering, for the investigation of new manufacturing processes, equipment, materials and their application to motor-cars, commercial vehicles and other products without regard to the conventional. Location, Oxford. (Ref. A.C.H.)

PLANT LAYOUT ENGINEERS

Layout Engineers with experience of Shop Loading and Shop Layout for large-scale production. Location, Oxford. (Ref. R.S.)

These openings offer the opportunity for those well-qualified technically, with experience in the above-mentioned capacities, to join an expanding Organisation. Conditions of employment accord with best industrial practice. Applications with full details of education, training, experience and salaries earned, may be made to the Staff Officer, Cowley, Oxford, or to the Personnel Manager, Stratton St. Margaret, Swindon, as appropriate.

E5575 A

ATOMIC ENERGY ESTABLISHMENT WINFRITH

PROFESSIONAL ENGINEERS are required by the Reactor Services Group for the preparation of specifications, design and commissioning of instrumentation, control systems, equipment for research reactors and associated experimental equipment.

Applicants should be Corporate Members of the Institution of Electrical Engineers or have equivalent qualifications. Previous experience in the fields of industrial process control, electronics and telephone type circuit technique would be an advantage.

SALARY : from £845 (at age 25) to £1800 p.a., according to age, qualifications and experience.

Send POSTCARD for application form and details to Personnel Branch (W.91/25), U.K.A.E.A., A.E.E., Winfrith, Dorchester, Dorset.

E5525 A

Classified Advts. continued on page 124

SITUATIONS VACANT

THE BAHRAIN PETROLEUM COMPANY LIMITED

Have vacancies for

PLANT INSPECTORS

at their Bahrain oil refinery. Applicants should have a Degree in METALLURGY, PHYSICS, CHEMICAL or MECHANICAL ENGINEERING, and should be under 35. Duties of PLANT INSPECTORS consist principally of inspection of pressure vessels, heat exchange equipment, furnaces, steam boilers and ancillary equipment, and recommending repairs thereto to ensure safe and economical operation. A knowledge of the applicable construction codes (A.P.I. and A.S.M.E.) and previous experience in inspection, design or construction of pressure vessels, heat exchange or boiler equipment or equivalent industrial experience, is preferred ; but graduates without this experience will be considered for training for these vacancies.

Salary would be in the range £1100 to £1400 per annum, in accordance with qualifications and experience, in addition to which free air conditioned accommodation and a living allowance are provided. An initial kit allowance, medical attention, paid home and local leaves are also provided, with passage paid for the former and generous assistance towards fare for latter.

Apply in writing, with full particulars, to Caltex Services Limited, Caltex House, Knightsbridge Green, London, S.W.1, quoting " INS."

E5574 A

SITUATIONS VACANT

THE PLESSEY COMPANY LIMITED, SWINDON, WILTSHIRE

Invite applications for the position of

SHOP SUPERINTENDENT

in our department which is now producing Engineering Components by the SINTERING OF METAL POWDERS.

Applicants should have had at least five years' experience in this field, especially with regard to its practical side.

The post carries a good salary with prospects of improvement.

Full information may be given in confidence to the Employment Officer, The Plessey Co. Ltd., Kembrey Street, Swindon.

E5572 A

SITUATIONS VACANT

MECHANICAL ENGINEERING

and

PLANT LAYOUT DRAUGHTSMAN

required, 25-35 years of age, with good engineering background. Experience in general cable-making machinery detailing and/or cable factory plant and services layout, whilst not being essential, would be an advantage. Five-day week. Salary A.E.S.D. plus, according to qualifications and experience.—Write, stating age, experience, &c., to the Personnel Officer; British Insulated Callender's Cables, Ltd., Leigh, Lancs.

E5483 A

FORD

MOTOR COMPANY LIMITED

have a vacancy for an

ASSISTANT MECHANICAL ENGINEER

Applications are invited for the above vacancy from candidates possessing good technical qualifications and experience in the manufacture, erection and maintenance of mechanical plant in modern power stations, also experience of steam transmission and distribution systems for industrial estate purposes. Drawing-office experience an advantage.

Duties in the first instance will chiefly consist of assisting in development work associated with the current Power Services Expansion Programme.

Candidates should apply to Head, Training and Recruitment Department (O12), Ford Motor Company, Limited, Dagenham, quoting reference TME.

E5556 A

SUTCLIFFE, SPEAKMAN & CO., LTD., LEIGH, LANCASHIRE.

have a vacancy for

A PROJECT ENGINEER

This is a senior position and applicants should be over 30, hold an engineering degree and/or membership of a senior mechanical engineering institution.

As the company designs and manufactures plants requiring knowledge of both mechanical and chemical engineering, experience in chemical engineering would be an advantage.

The position carries responsibilities, offers scope and commands a good salary. Other benefits are, a Pension Scheme, Life Insurance, and Sharing of Profits.

Write in confidence giving details of qualifications and experience to :

Personnel Superintendent,

Reference P.E.,

SUTCLIFFE, SPEAKMAN & COMPANY, LIMITED,

Leigh, Lancashire.

E5351 A

OPPORTUNITIES FOR GRADUATES

THE GLACIER METAL COMPANY LIMITED

The Company is the largest manufacturer in Europe of plain bearings, its products varying in size from under one ounce to over a quarter of a ton and in quantities from single units to runs up to half a million. Engineering processes are wide and diverse and cover all stages of manufacture from casting to final machining. The Company makes its own special machine tools. Continuous technical development is taking place in this most basic engineering component. There is a large research organisation and Glacier processes are operated under licence all over the world. In addition, the Company gives much importance to the development and staffing of a clear organisational structure. To meet the needs for future Managers and Technologists, the following entry schemes are operated for Graduates.

GLACIER GRADUATE APPRENTICESHIPS

This course has two objectives :—

(1) A practical training in Engineering, during which the Graduate " learns his tools," has actual experience of setting and operating machines, operates production procedures, and covers all kinds of engineering and the principles of workshop practice. Modern activity methods of teaching are used, i.e. to the maximum extent possible Graduates carry out the operations they are learning.

(2) Theoretical training in industrial organisation, within a syllabus based on research carried out by the Company.

The course is based on London and normally lasts two years, although Graduates making good progress may enter permanent positions in the Company before this time. Salary from £550 to £825 p.a., according to qualifications, age and experience.

GLACIER MANAGEMENT TRAINEESHIPS

The object of this course is specifically to train men with potentiality for eventually filling senior posts in the Company. It covers some two years of general training, of which a part may be spent abroad. As well as formal training events, the course consists of a number of theories during which trainees carry out actual jobs of work in the main areas of company activity. Each period is centred around a project, during which the trainee is expected to study some particular aspect of the job in hand. Regular career discussions are held with trainees. Entrants should have a good University Degree and should have completed recognised apprenticeship. Salary from £675 to £925 p.a., according to qualifications, age and experience.

SPECIAL ASSIGNMENT GROUP

This consists of a group of engineers attached to the Chief Production Engineer at Company Headquarters. On entering this group, members are deployed to work on special projects chosen to allow the new member to make an immediate impact in the work of the Company. Assignments, which are of great interest and often concern new developments, typically, last for some months each, and may take place in any of the Company's factories in London, Manchester or Glasgow. After spending up to 18 months in this group, members are eligible to take up permanent positions in the Company. Salary from £900 to £1350 p.a. To warrant a salary towards the top of this range entrants would be expected to have had some practical experience in addition to the possession of a degree and the completion of an apprenticeship.

Selection for all these entry schemes will take into account both academic level, experience and all-round personal qualities. Applications from young men who wish to be considered for one of these appointments should be sent to :—

THE PERSONNEL DIRECTOR,

GLACIER METAL COMPANY LIMITED,

EALING ROAD, ALPERTON, WEMBLEY, MIDDLESEX.

E5571 A

DESIGNER-DRAUGHTSMEN

REQUIRED URGENTLY BY

KELLOGG

INTERNATIONAL CORPORATION

(PIPING, SENIOR STRUCTURAL (STEEL), ARCHITECTURAL, ELECTRICAL)

Designer-draughtsmen of the above categories are cordially invited to contact us with a view to permanent employment. Candidates must hold Higher National Certificate or equivalent plus five to seven years' design experience. Successful applicants will benefit from excellent salaries, first class working conditions, attractive personnel benefits and every opportunity for promotion. Apply to Personnel Manager,

KELLOGG INTERNATIONAL CORPORATION

7-10, CHANDOS STREET, CAVENDISH SQUARE, LONDON, W.1.

Tel. : MUSeum 4010 (Please quote reference 134/G)

E5590 A

ENGINEERING DESIGN IN THE RUBBER MANUFACTURING INDUSTRY?

. . . a pertinent question, but one which is easily answered. Never before have there been greater opportunities for DRAUGHTSMEN DESIGNERS than exist to-day at Fort Dunlop—the largest factory in the DUNLOP GROUP. Modern manufacturing techniques call for qualified men with imagination and drive. These openings are in the field of

MECHANICAL ENGINEERING

and are as follows :—

Design draughtsmen with National Certificates and appropriate experience are required for projects connected with the modernisation and expansion of both the Fort Dunlop tyre factory and overseas factories of the Dunlop Group. Preference will be given to those with experience of one or more of the following : factory services, plant layout and mechanical handling or special-purpose machine design.

Applications are invited from suitably qualified men, aged 28-43, *who should write in confidence, giving details of experience and commencing salary expected, to*

PERSONNEL MANAGER (DO), FORT DUNLOP, ERDINGTON, BIRMINGHAM, 24.

E5565 A

SITUATIONS VACANT

ENGLISH ELECTRIC

Vacancies have arisen in the

MECHANICS OF SOLIDS GROUP

of the

MECHANICAL ENGINEERING LABORATORIES

at

Whetstone, Near Leicester.

Applications are invited from Graduate Engineers, Physicists or Mathematicians with engineering interests, to work in the general field of Vibration Analysis and Strength of Materials. Successful applicants would be working in the following fields and a particular interest in one or more of these would be an advantage.

VIBRATION ANALYSIS
Critical Speed Research
Turbine Blade Vibrations
Diesel Engine & Gas Turbine Investigation
Mechanical Impedance Methods
Dynamic Analogues

STRESS ANALYSIS & STRENGTH OF MATERIALS
Pressure Vessels and Duct Work
Photoelasticity
Loco & Diesel Engine Frame Design
High Strain Fatigue
Properties of Materials

The services of a DEUCE Digital Computer are available.

Please write, giving brief details of qualifications and experience, to Dr. H. G. Edmunds, Dept. C.P.S., Marconi House, 336/7, Strand, W.C.2, quoting reference E1917H. E5523 A

CENTRAL ELECTRICITY GENERATING BOARD

REGIONAL RESEARCH AND DEVELOPMENT OFFICER

The Generating Board are embarking on a progressive and permanent research organisation with research establishments both at the Centre and in the Regions, and an officer to fill this position is required in the North West, Merseyside and North Wales Region to lead a team on research and field development work involving metallurgy, chemistry and electronic engineering in relation to power station generation and high tension transmission problems.

Prospective candidates should have a sound technical education, preferably a University Degree with honours, coupled with the qualities of initiative, vision and drive.

Salary scale £2,100/2,900.
Contributory pension scheme.

Applications in strict confidence, stating age, education, qualifications and experience, should be sent to DIRECTOR OF LABOUR AND WELFARE, CENTRAL ELECTRICITY HOUSE, 825, WILMSLOW ROAD, MANCHESTER, 20, by 30th April, 1959. Please quote reference E.150/142/H. E5564 A

GKN

The Guest, Keen & Nettlefolds Group of Companies

wish to make the following appointment in one of their constituent companies.

CHIEF DESIGN ENGINEER

An experienced Chief Design Engineer is required by an already large but continually expanding company in the Midlands to lead a design team for the manufacture of special purpose machinery and automatic handling equipment for metallurgical processes.

The appointment offers considerable scope for development. Preferred age 30–40, but exceptionally qualified candidates outside this bracket would be considered.

Appropriately qualified men who consider that they have had relevant experience are invited to write, stating full details of age, qualifications, career to date, &c., to the Group Personnel Officer, Guest, Keen and Nettlefolds, Ltd., 66, Cannon Street, London, E.C.4. E5563 A

TECHNICAL MANAGER

TECHNICAL MANAGER required for Division of a large Public Company, engaged in the light and medium heavy engineering industry, to be responsible for all Engineering, including Design and Development, and to represent the Division in the technical field.

Candidates should have considerable experience of design and manufacture in the Railway Rolling Stock Industry in a Senior Executive capacity, coupled with substantial engineering qualifications.

The appointment, which is a senior one, arises from continued expansion of the Company and offers considerable opportunities. Remuneration will be commensurate with the scope of the position, governed by experience and qualifications.

Applications, with full details of curriculum vitae and salaries earned will be studied at Board level and may be made in strict confidence to Box No. 2448, c/o Charles Barker and Sons, Ltd., Gateway House, London, E.C.4. E5444 A

SITUATIONS WANTED

MACHINE SHOP SUPERINTENDENT (45 years) desires change. 19 years' full control of shops and production units. Experienced in batch and one-off production. Heavy and light components. Progressive position required with salary commensurate with ability. Available May 25th.—BOX No. E2361, "The Engineer." B

A.M.I.MECH.E. SEEKS CHANGE OF EMPLOYMENT. Experience in management of department dealing in hydraulic presses and metallurgical equipment, consisting of design, estimating, sales, supervision of construction and testing. Full deeded apprenticeship in general engineering and drawing-office experience.—BOX No. E2371, "The Engineer." B

SALES PROMOTION ENGINEER, knowledge overseas countries, German, French, with sound general engineering background and good commercial training and experience, seeks change.—BOX No. E2370, "The Engineer." B

BUSINESSES and PREMISES

HAMMERSMITH BRIDGE. 6300 square feet modern S/S factory or Warehouse. Excellent natural light. Headroom 14ft. 6in. Overhead 3-ton travelling crane. Central heating. Good loading entrances for large vehicles. FREEHOLD FOR SALE. CHAMBERLAIN AND WILLOWS, 23, Moorgate, E.C.2. (MET. 8001). E5530 L

FOR HIRE

LATTICE STEEL. Erection Masts (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1. ('Phone, SLOane 5259). E103 K

MACHINERY Etc. WANTED

MARKING-OFF TABLE, 16ft. by 8ft., second-hand, in good condition.—BOX No. E5566, "The Engineer." F

WANTED, MODERN PLANO-MILLING MACHINE 16ft. by 5ft. by 5ft. in first class condition. Send full specification including year of manufacture and price.—BOX No. E2349, "The Engineer." F

REQUIRED, FOR EXPORT, second-hand or reconditioned 6-ton Level Luffing Wharf Cranes, preferably Stothert and Pitt.—Offers to BOX No. E2365, "The Engineer." F

THE COMMISSIONERS FOR THE PORT OF CALCUTTA

The Commissioners for the Port of Calcutta wish to PURCHASE or CHARTER a TWIN-SCREW SAND SUCTION HOPPER DREDGER for service on the River Hooghly, with the following characteristics :—

1. Dredging depth 45–55ft.
2. Pumping capacity not less than 3000 tons of solids per hour at 20 per cent. concentration.
3. Draught, if possible, not to exceed 17ft. loaded.
4. Hopper capacity between 2500 and 4000 tons.
5. Service speed not less than 9½ knots and preferably higher.
6. The dredger to be fitted with a bow or centre well, preferably the former. Stern well will not be considered.
7. Dumping preferably through Lister valves. If hopper doors are fitted, the increase in draught with the doors open to be stated.
8. The dredger to be steam driven, preferably with oil-fired boilers.

If a suitable dredger is available for charter for a period of not less than two years, the Commissioners would consider Diesel-Electric propulsion if suitable qualified engineers were available with the ship.

Offers not conforming to the above specifications will also be considered if necessary modifications can be carried out within reasonable limits without affecting its performance to suit our requirements.

A Committee of Experts will examine the dredgers selected and the seller should extend them all facilities.

Particulars of the craft should be forwarded to the Deputy Conservator, Commissioners for the Port of Calcutta, 15, Strand Road, Calcutta, 1, and also to Messrs. Rendel, Palmer and Tritton, 125, Victoria Street, Westminster, London, S.W.1.

C. J. MOHAN,
Deputy Conservator.

Calcutta, dated the 26th February, 1959. E5318 F

SUB-CONTRACTING

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process ; sample castings treated ; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone Byron 1178). E109 MW

KELLERING AND CAM PROFILING capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone : Knottingley 2743/4). E116 MW

DRAWING - OFFICE. — CAPACITY FOR DESIGN, DETAILING AND TRACING. Specialists in technical illustrating. Old-established firm who do work throughout the British Isles.—Associated Engineering Products, Arcade Chambers, Eltham, S.E.9. Telephone, ELT 2233/4 E2368 MW

MISCELLANEOUS

TIME RECORDERS, Sales, Rentals, Service, Telephone Hop 2239.—Time Recorder Supply and Maintenance Co., Ltd., 157–159, Borough High Street, London, S.E.1. E110 I

FOR SALE

Edwards

TWO NEW BESCO Type F 80½in. by 14 gauge, Hand-Operated, Universal Swing Beam, Folding Machines, with high-lift clamping beam and adjustable bed, smallest trunk section formed 11in. by 9½in., maximum working length 80½in., capacity mild steel 18 s.w.g., height of lift of clamping beam 6in.

WESTON Model 400/100, Double-Sided Friction Screw Press, of welded steel plate construction ; arranged motor drive for 400/3/50 ; pressure exerted approximately 120 tons, maximum stroke 11in., diameter of screw with four starts 6¼in., size of bed 21½in. by 18in. Weight approximately 5 tons 8 cwt.

NEW BRUECK Type 20/1600, All-Steel, Motorised Press Brake, motorised for 400/440/3/50, maximum pressure 20 tons, forming capacity 63in. by ¼in. Approximate weight 36 cwt.

TAYLOR and CHALLEN Power-Operated Circle Cutting Machine, motorised for 400/440/3/50, capacity 16 s.w.g. mild steel, cuts circles from 7in. to 52in. diameter. Weight approximately 8 cwt.

RUSHWORTH Power-Operated, Double-Geared, Open-Ended Guillotine Shearing Machine, overcrank type, arranged motor drive for 380/440/3/50, capacity mild steel 4ft. by ¼in., gap in open ends 6½in. Weight approximately 50 cwt.

NEW MUBEA All-Steel Construction Bar and Angle Shear, arranged motor drive for 400/3/50 ; capacity : round bars 2in., square bars 2in., flat iron 10in. by ½in., 5½in. by 1in., angles up to 4in. by ½in., 5in. by 0·425in., tee iron 5in., beams 6in., channels 6in. ; length of blades 12½in.

TAYLOR and CHALLEN No. 6 G.D.P., Double-Sided, Double-Action, Double-Geared Toggle Drawing Press, arranged motor drive for 400/440/3/50, punch stroke 16in., blankholder stroke 9½in., between uprights 38in.

Photographs of the above are available.

Very favourable Hire Purchase terms can be obtained.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

F. J. EDWARDS LTD.,

359–361, EUSTON ROAD,
LONDON, N.W.1.
Telephone : EUSton 4681–3771.
And at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone : Central 7606–8. E207 G

FOR SALE

5-ton capacity, Low Headroom, Lattice Girder, Overhead CRANE by Royce, new 1936, 220V, d.c., 54ft. 3in. span, cab-controlled. £600 f.o.t.

600 h.p. totally enclosed Oil-Cooled Double Reduction GEARBOX by Turbine Gears, ratio 730 r.p.m./38 r.p.m., unused.

F. BURRILL AND CO.,
235a, Cathedral Road, Cardiff.
Tel. : 26100. E5492 G

FOR SALE

FRED WATKINS (ENGINEERING), LTD.

STEAM BOILERS.—Cochrane Vertical (New), 8ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia., 100/150 lb. w.p. ; reconditioned 8ft. 6in. down to 3ft. dia. ; Economic 4ft. to 11ft. 6in. dia., including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p. ; 300 reconditioned Vertical Crosstube, all sizes.

AIR COMPRESSORS.—Two Belliss & Morcom 2500 c.f.m., 100 p.s.i., 550 h.p. motors ; also Broomwade 500, 400, 300, 200 and 130 c.f.m., all motorised ; and several others of various makes and capacities.

200 AIR RECEIVERS, stocked up to 9ft. dia., 100 to 500 lb. pressure.

ELECTRIC MOTORS.—150 Totally Enclosed and Flameproof Motors up to 100 h.p.

MOBILE ROAD CRANES.—10-ton Lorain lorry mounted, 30ft.–70ft. extendible jib ; 10-ton 33 R.B. track mounted, 40ft. jib ; 8½-ton Ransomes Diesel/Electric, 21ft. jib ; 6-ton Coles Diesel/Electric, pneumatics, new 1948 (2) ; 6-ton Coles Diesel/Electric, solids ; 4-ton Coles Diesel/Electric, solids, 1945 ; 4-ton Jones KL44, diesel, 1950 ; 3-ton Jones "Super 40" diesel, pneumatics (3).

OVERHEAD CRANES.—40-ton Babcock, 40ft. span, 400/3/50, "Goliath" ; 30/5-ton Adamson, 42ft. 3in. span, 400/3/50 ; 20/6-ton Vaughan, 42ft. 3in. span, cab type (6) ; 20-ton King, 42ft. 3in. span, 400/3/50 ; 15-ton Morris, 35ft. span, hand operated ; 10-ton Morris, 45ft. span, 36ft. lift ; 10-ton Morris "Goliath," 40ft. span, 400/3/50 ; 10-ton Vaughan, 23ft. 6in. span, 400/3/50 ; 10-ton Vaughan, 21ft. span, 44ft. lift ; 7½-ton Wharton, 25ft. span, 400/3/50 ; 5-ton Henderson, 24ft. 7in. span, 1946 ; 5-ton Morris, 58ft. span, hand operated ; 5-ton Royce, 2-motor crab, 440/3/50 ; 5-ton King, 29ft. 3in. span, power hoist, hand travel ; 5-ton Morris, 28ft. 6in. span, power hoist, hand travel ; 4-ton Morris, 19ft. span, 220V., d.c. (3) ; 3-ton Adamson, 48ft. span, 400/3/50 ; 2-ton Adamson, 34ft. span, 400/3/50 (2) ; 2-ton Morris, 18ft. span ; 2-ton Vaughan, 27ft. 6in span, 2-motor ; majority of the above are unused.

DERRICK CRANES.—7-ton Rushworth hand, 30ft. jib ; 5-ton Wilson Electric, 70ft. jib ; 1½-ton Anderson Grice, hand, 40ft. jib.

RAIL CRANES.—18-ton Brownhoist, steam, 50ft. jib ; 10-ton Coles steam, 40ft. jib ; 10-ton Grafton, 34ft. jib, diesel conversion ; 8-ton Wilson steam, 35ft. jib ; 5-ton Grafton, 35ft. jib, diesel conversion ; 5-ton Smith, 50ft. jib (2) ; 5-ton Cowans Sheldon, 50ft. jib.

LOCOS.—Fowler diesel, 150 h.p. (2) ; Ruston diesel, 80/88 h.p., new 1942 ; Bagnall 14in. by 22in., two oil fired, one coal ; Peckett steam, 7in. by 12in., 1941 ; also 3 miles track, 24in. gauge, Bogies, Turnouts, &c.

STEEL PIPING.—50,000ft., 2in. Galvanised, new ; 60,000ft., 3in. black, new ; 5000ft., 8in. seamless ; 1000ft., 12in. seamless ; 500ft., 14in. seamless ; 400ft., 18in. riveted ; 280ft., 21in. o.d. welded flanged ; 3800ft., 21in. seamless flanged ; 500ft., 24in. riveted ; 1450ft., 27in. o.d. welded flanged ; 216ft., 48in. riveted ; 216ft., 60in. riveted.

CAST IRON PIPES.—Large stocks all sizes up to 24in. flanged and s.s. Immediate delivery.

VALVES.—Exceptional Surplus Ministry Lot New Stainless Acid Cocks and Valves, over 5000, immediate delivery, below makers' prices. Large stock all sizes, Parallel Slide Sluices, Gunmetal, Reducing and Check Valves. List on request.

STORAGE TANKS.—300 cylindrical and rectangular up to 12,000 gallons, for oil and petrol, also sectional steel and cast iron up to 50,000 gallons.

MACHINE TOOLS.—Scriven Plate Bending Rolls, 14ft. by ½in. ; Robertson Straightening Rolls, 8ft. 6in. by ½in. ; Berry Bending Rolls, 7ft. by ½in. ; Tangye 200-ton Hydraulic Vertical Straightening Press, 15ft. by 3ft. table ; Herbert 3ND Miller, 61in. by 15in. table ; Peels Punch and Shears, ½in. capacity ; nine new 2 cwt. and 1 cwt. Pneumatic Hammers ; Bliss 14T Tapering Press ; Bonn Hydraulic Tube Bender up to 20ft. by 4in. bore ; Bigwood geared Bending and Straightening Machine up to 12in. by 6in. R.S. Joists ; two 40kVA. Spot Welding Machines ; Wire Drawing Machine, 3 die up to ¼in. copper ; 50kW. Electric Furnace, 1000 deg. Cent., chamber 54in. by 30in. by 21in.

SLING ENGINEERING WORKS
COLEFORD, GLOS.
'Phone : Coleford 2271/2. E106 G

600

SPECIAL OFFER

Two only virtually unused 3-motor ELECTRIC OVERHEAD TRAVELLING CRANES, arranged for floor control, suitable for supply of 400 volts, 3-phase, 50 cycles. New 1955. Capacity 7 tons, 48ft. 0in. span, lift 30ft.

These cranes have only seen a few months' use and are equal to new.

GEORGE COHEN,

SONS AND CO. LTD.
600, WOOD LANE, LONDON, W.12.
E204 G

FOR SALE

Plate Straightening Rolls, capacity 8ft. by 1½in., 5 roll with 30 h.p. 400/3/50 motor and reversing controller.

Plate Bending Rolls, capacity 30ft. by 1½in. Fully motorised 400/3/50. Makers "Bennie."

Both in first class condition available in 4–6 weeks. Apply :

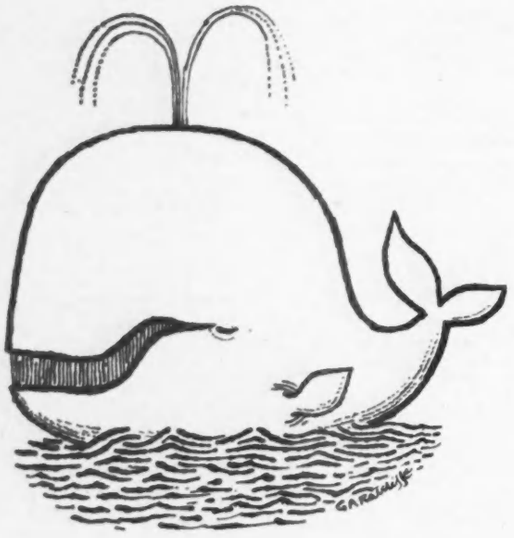
G. E. SIMM (MACHINERY), LIMITED,
27, Broomgrove Road, Sheffield, 10.
Tel. : 64436 E5481 G

ONE 10-TON ELECTRIC LUFFING AND TRAVELLING JIB CRANE by Cowans, Sheldon and Co., Ltd. 50ft., maximum radius of jib, maximum lift above rail level 45ft., motorised 230 volts d.c.

JOHN CASHMORE, LTD.,
NEWPORT, MON. E154 G

STOTHERT AND PITT PEDESTAL TYPE CRANE, 2 tons capacity ; in excellent condition. Can be seen working. £4000 ex site for prompt sale. —BOX No. E5560, "The Engineer." G

Classified Advts. continued on page 126



We're not kidding but that whale enjoys using one of Natures finest filter plants

We make the finest industrial filter equipment whether from natural or synthetic materials

If its a whale of a job give it to

COTTON BROS Longton Ltd

CROWN WORKS
PORTLAND ROAD
LONGTON
STOKE-ON-TRENT
STAFFORDSHIRE

Telephone LONGTON 33021 (3 lines)
Telegrams "COTBRO" Stoke-on-Trent

we filter through industry

FOR SALE

HYDRAULIC PRESSES
HYDRAULIC PUMPS

Hydraulic Accumulators, Valves, Fittings, New and Second-hand. Complete installations.
All kinds of Hydraulic Equipment in Stock.
THOMPSON AND SON (MILLWALL), LTD., Cuba Street, Millwall, London, E.14.
East 1844/5. E111 G

BRITISH TRANSPORT COMMISSION
SWANSEA DOCKS

FOR SALE IN SITU, a SCHERZER ROLLING LIFT BRIDGE, constructed in 1912, spanning a water channel of 100ft. in width. The bridge is electrically operated and carries a roadway with a single line of rail track laid thereon, and must be removed by the purchaser on sale.
Application for further particulars or for arrangements to inspect should be made to Dock Manager, B.T.C., Adelaide Street, Swansea.
Offers should be forwarded to reach the Chief Docks Manager, B.T.C., South Wales Docks, Pierhead Building, Cardiff, not later than 31st May, 1959.
E5583 G

YOU'RE ON YOUR TOES when you remember WARDS might have it!

THOS. W. WARD LTD
ALBION WORKS, SHEFFIELD

FOR SALE

NISSEN TYPE HUTS for sale. Prompt despatch of 16ft., 24ft. and 30ft. wide huts; also "Romney" Huts, 35ft. wide, and "Blister" Hangars, 86ft. 6in. and 91ft. wide. These buildings are in various lengths and comprise steel framework with galvanised corrugated steel sheeting.—Full details from Dept. 115, J. Thorn and Sons, Ltd., Brampton Road, Bexleyheath, Kent (Tel.: Bexleyheath 305).
E113 G

FOR SALE

ASQUITH 5FT. MODEL L.D.I. RADIAL DRILLING AND TAPPING MACHINE
No. 4 M.T., with loose box table.
F. J. EDWARDS LTD.,
359-361, EUSTON ROAD,
LONDON, N.W.1.
Phone: EUSton 4681 and 3771.
E5528 G

L. STORHAUG AND PARTNERS, LTD.

One 3-drum Yarrow type BOILER, 100,000 lb. steam per hour—unused.

Two Ruston and Hornsby DIESEL GENERATING SETS, 300kW., 220 volts, 428 r.p.m.

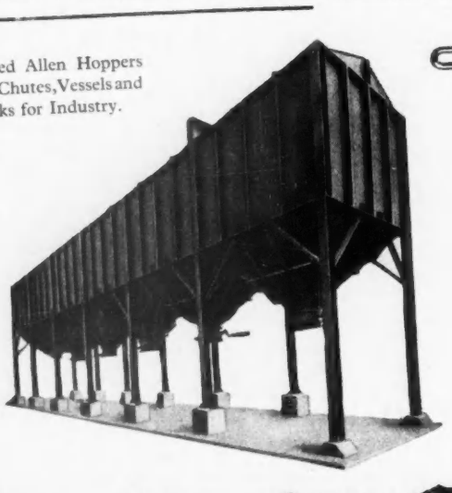
One 200kVA., 400 volts, 3-ph., 50 cycles, Mirrlees DIESEL GENERATING SET.

25, FINSBURY COURT,
FINSBURY PAVEMENT, LONDON, E.C.2.
E147 G

FOR SALE, Halden New Premier Photo Print Drying Machine, for prints up to 44in. wide, B2172/5157 model, electrically heated, complete with motor, in reasonably good condition.—Inquiries to view machine to Chief Locomotive Draughtsman, Locomotive Drawing Office, Doncaster (telephone No. 4417, Ext. 37), and offers to Stores Superintendent, British Railways, Wellers Court, King's Cross, London, N.W.1. E5558 G

FOR SALE, two new 15 h.p. L.S.E. Variable-speed, totally enclosed Motors, 415 volt, 3-phase, 50 cycle, complete with control gear. Can be seen by appointment.—Full details, BOX No. E5550, "The Engineer." G

Alfred Allen Hoppers and Chutes, Vessels and Tanks for Industry.



Contact Alfred Allen! They're the right people for Platework. We can rely on the accuracy and quality of their workmanship absolutely. B.D.

alfred allen & SON LTD
LOWER GORNAL, Nr. DUDLEY

London Office: 23 LAWRENCE LANE, E.C.2. TEL. MONARCH 2978
A6588A

AUCTIONEERS & VALUERS

HENRY BUTCHER
AND CO.

Auctioneers, Valuers and Surveyors

Specialising in the

SALE & VALUATION

of

ENGINEERING & ALLIED WORKS PLANT & MACHINERY

73, Chancery Lane, London, W.C.2.

HOLBORN 8411 (8 lines)

By Order of The Aston Construction Co. Ltd.
EAGLE WHARF ROAD, LONDON, N.1.

Henry Butcher & Co.
are instructed to offer for SALE BY AUCTION in LOTS at THE WORKS on
THURSDAY, 14th MAY, 1959
at ELEVEN A.M., the

PLANT AND MACHINERY

including :
"CLIFTON & BAIRD" COLD SAWS to 42in.
"BENNIE" HEAVY DUTY PLATE SHEARS
"SCRIVEN" PUNCHING MACHINE
"BENNIE" DOUBLE ACTION ANGLE CROPPER
"CLIFTON & BAIRD" 4 TOOL PLATE BENDING MACHINE
"ASQUITH" 7ft. & 8ft. RADIAL GIRDER DRILLS
"BESCO" PLATE BENDER
"DE BERGUE" RIVETTING MACHINES UP TO 40 TON PRESSURE
OIL FIRED & ELECTRIC FURNACES
"HANCOCK" TYPE MK. 3 CIRCALINE OXYGEN CUTTING MACHINE
S.S. & S.C. CAPSTAN & TURRET LATHES
By Herbert, Mitchell, Cardiff, Foster and Colchester
"SWIFT" 10ft. by 3ft. PLANING MACHINE
HORIZONTAL MILLING MACHINES
POWER HACKSAWS. AIR COMPRESSOR SETS
SAW & TOOL GRINDING MACHINES
BALLINGER TYPE C MOTORISED ABRASIVE CUT-OFF.
BENCH & PEDESTAL GRINDERS
Woodworking Machines, Portable Air Grinders & Hammers.
SINGLE & DOUBLE BEAM TRAVELLING CRANES
OFFICE FURNITURE & EQUIPMENT
Catalogues (when ready), price 6d. each, may be obtained of :
Messrs. HENRY BUTCHER & CO., Auctioneers, Valuers & Surveyors of Factories, Plant and Equipment, 73, Chancery Lane, London, W.C.2.
Telephone : HOLborn 8411 (8 lines). E5582 J

FOR SALE

600

SPECIAL OFFER

HEAVY-DUTY FORK LIFT TRUCKS

Capacity	18,000 lb. at 33in. centres	15,000 lb. at 24in. centres
Make	Shelvoke and Drewry	Ransomes and Rapier
Lift	17ft. 6in.	17ft. 6in.
Engine	Perkins P.6	Perkins P.6
New	1956	1956
Tyres	Pneumatic	Pneumatic

Also available, Second-hand FORK LIFT TRUCKS of 4000 lb. capacity, fitted with diesel engines.

GEORGE COHEN,
SONS AND CO. LTD.
600, WOOD LANE, LONDON, W.12.
E202 G

FOR SALE

RAILWAY TURNTABLE
For Sale.—Mundt type standard gauge turntable, 65ft. long, carrying capacity 150 tons approx.
WATER CRANE
3000 gallon water crane.
TURNOUTS
Twenty 1 in 8 turnouts in 75 lb. F.B. rail ; interchangeable to suit L.H. or R.H.
All these items are in excellent condition.
Apply : EAGRE CONSTRUCTION CO., LTD., East Common Lane, Scunthorpe, Lincs. ('Phone : 4513). E150 G

FOR SALE.—125kVA. RUSTON/MATHER & PLATT, 365/440 volts, 3 ph., 50 c. Diesel Alternator Set. Type 3 V.E.A. cold-starting engine, air-starting. Stand-by set, little used. Bargain before removal. —JOSEPH PUGSLEY & SONS, LTD., Bristol, 5. Tel.: Bristol 56037. E5389 G

AUCTIONEERS & VALUERS

ESTABLISHED 187?

LEOPOLD FARMER & SONS

conduct

AUCTION SALES and VALUATIONS

OF PLANT, MACHINERY AND INDUSTRIAL PROPERTIES

FACTORY INVESTMENTS MORTGAGES ARRANGED

46, GRESHAM STREET, LONDON, E.C.2.

Telephone : Monarch 3422 (8 lines) Telegrams : Sites, London

JOHN FOORD
& COMPANY

VALUERS AND ASSESSORS

OF WORKS, FACTORIES ENGINEERING PLANT AND MACHINERY

56, VICTORIA STREET, LONDON, S.W.1.

VICTORIA 2002/3/4

Established Over a Century

By Order of Catford Instruments, Ltd., Owing to Compulsory Acquisition of Property.
DEPTFORD, S.E.8.

MODERN JIG & TOOL PLANT

S.S. and S.C. Lathes up to 7½in. centres by Willson, Smart & Brown, Littlejohn, &c. Surface and Bench Grinders, Drilling and Tapping Machines, Milling Machines, All types by Archdale, Denbigh, &c. FINE MEASURING TOOLS, Surface Plates, Verniers, Slip Gauges, Micrometers, &c., Guillotines, Folding Machines, Fly Presses, Milling Tables, Dividing Heads, Machine Equipment, Portable Electric Tools, Welding Plant, Drills, Milling Cutters and Small Tools, Coil Winders, Electrical Measuring Instruments, Hand Tools and Utensils, Office Furniture.

Leopold Farmer & Sons
will Sell the above BY AUCTION on the Premises, BEVIL ST., DEPTFORD, S.E.8, On TUESDAY, 5th MAY, 1959, at 11.00 a.m.
On View Day Prior and Morning of Sale.
Catalogues (price 6d.) each of : Leopold Farmer & Sons, Industrial Property, Plant & Machinery Auctioneers, Surveyors and Valuers, 46, Gresham Street, London, E.C.2. Telephone : MONarch 3422 (8 lines). E5447 J

FOR SALE

NEW GIUSTINA MODEL RU 300/750 12in. by 30in. UNIVERSAL CYLINDRICAL HYDRAULIC GRINDER. Due to cancelled contract machine offered at considerably less than current price.

JOSEPH PUGSLEY AND SONS, LTD.,
Bridge House, Bristol, 5.
Tel. : Bristol 5-6037. E5485 G

HYDRAULIC PRESSES

3000-ton PLATE FORMING AND BENDING PRESS, table 16ft. by 4ft. 6in., admits 10ft. 6in. between columns.
2000-ton HYDRAULIC FORGING PRESS, admits 8ft. 6in. between columns.
1000-ton HYDRAULIC FORGING PRESS by Wellman, admits 6ft. between columns.
LARGE STOCK OF HYDRAULIC PRESSES OF ALL TYPES.

REED BROTHERS (ENGINEERING), LTD.,
REPLANT WORKS,
WOOLWICH INDUSTRIAL ESTATE,
LONDON, S.E.18.
Telephone : Woolwich 7611/6. E5140 G

AUCTIONEERS & VALUERS

Established 1850

WHEATLEY KIRK PRICE & CO.

E. L. JUDSON, F.R.I.C.S., F.A.I.
E. BEDDARD, A.I.MECH.E., F.A.I.P.A.
M. S. CHEAVIN, F.A.I.
G. E. GIBBS, F.A.I.P.A.

SURVEYORS, VALUERS and AUCTIONEERS of FACTORIES, PLANT and MACHINERY

FIRE LOSS ASSESSORS

9, REX PLACE, LONDON, W.1.
Telephone : HYDE PARK 8844/5/6 (3 lines)

AUCTIONEERS & VALUERS

Established 1807

FULLER, HORSEY
SONS & CASSELL

Specialists IN THE

SALE & VALUATION

OF

WORKS and MANUFACTORIES ENGINEERING PLANT and MACHINERY

10, LLOYD'S AVENUE
LONDON, E.C.3.

Telephone : ROYAL 4861

E R

By Order of the Minister of Supply

GOVERNMENT SURPLUS STORES

SALES BY AUCTION

		Main Location	*Auctioneers*
April 28–30	**Machine tools and miscellaneous stores.**	M.O.S. Storage Depot, Royal Arsenal, Woolwich, S.E.18.	FULLER, HORSEY, SONS & CASSELL (Dept. L), 10, Lloyd's Avenue, E.C.3. (Tel.: Royal 4861.)
May 6–7	**Miscellaneous stores,** including : large quantity of vehicle tyres and tubes ; machine tools ; welding machines ; road roller ; concrete mixers ; Johnson hot tar sprayer ; steel binning and racking ; Mack, Willys, Morris and other petrol engines ; M.T. spares ; sparking plugs ; wireless spares and electrical equipment ; steel units and corrugated sheeting ; furniture ; domestic boilers ; bedsteads ; platform trucks, etc.	M.O.S. Storage Depot, Rotherwas, Hereford.	RUSSELL, BALDWIN & BRIGHT, LTD. (Dept. L), 20, King Street, Hereford. (Tel.: 4366.)
May 12	**Miscellaneous stores.**	M.O.S. Storage Depot, Ruddington, Notts.	WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 54272.)
May 22	**Miscellaneous stores,** including hand tools, etc.	General Stores Sub Depot, Longtown, Nr. Carlisle. (Sale at County Hall, Carlisle.)	HARRISON & HETHERINGTON, LTD. (Dept. L), Botchergate, Carlisle. (Tel.: 26292/3.)
May 26	**Vehicles and miscellaneous stores.**	M.O.S. Storage Depot, Bowhouse, Hurlford, Nr. Kilmarnock.	DIXON & WALLACE, LTD. (Dept. L), Bank Buildings, Graham Square, Glasgow, E.1. (Tel.: Bridgeton 2447.)
May 29	**Miscellaneous stores.**	Command Ordnance Depot, Coypool, Marsh Mills, Plymouth. (Sale at Kinterbury House.)	WOOLLAND, SON & MANICO (Dept. L), Kinterbury House, St. Andrews Cross, Plymouth. (Tel.: 65356.)
June 2–5	**Vehicles, lifting and earth-moving equipment, motor cycles,** etc.	M.O.S. Storage Depot, Ruddington, Notts.	WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 54272.)
June 3	**Miscellaneous stores.**	Northern Command Ordnance Sub Depot, Barlow, Nr. Selby, Yorkshire.	BARTLE & SON (Dept. L), 50–52, Merrion Street, Leeds, 2. (Tel.: 2.0898.)

Applications for catalogues should be made *only* to the auctioneers shown above (price of catalogues 1s. 0d., P.O. only).

SALE BY TENDER

"FERRANTI" Mk. 1* Computer with paper reader, punch and Creed electric typewriter and primary power input alternators and refrigeration.

Tenders must be submitted by 14th May, 1959.

Applications for tender forms should be made to the Ministry of Supply, Directorate of Disposals, First Avenue House, High Holborn, London, W.C.1.

E118 J

FOR SALE

AIR COMPRESSOR SETS FOR IMMEDIATE DELIVERY

200 c.f.m. ALLEY and MACLELLAN Series 23B, two-stage, vee rope drive.
330 c.f.m. BROOMWADE type EH241, single-stage, with 75 h.p. motor.
400 c.f.m. BROOMWADE type TS1A, two-stage, with 90 H.P. motors (3 sets available).
495 c.f.m. BROOMWADE type EH251, single-stage, with 112 H.P. motors (2 sets available).
600 c.f.m. BROOMWADE type EH255, single-stage, with 135 H.P. motors (2 sets available).
540 c.f.m. INGERSOLL-RAND type XVH, 2-stage, with 130 H.P. motors (2 sets available).
All Compressors for 100 p.s.i., working pressure, all motors for 400/440 volts, 3-phase, 50 cycles.
LOW PRICES FOR QUICK SALE.

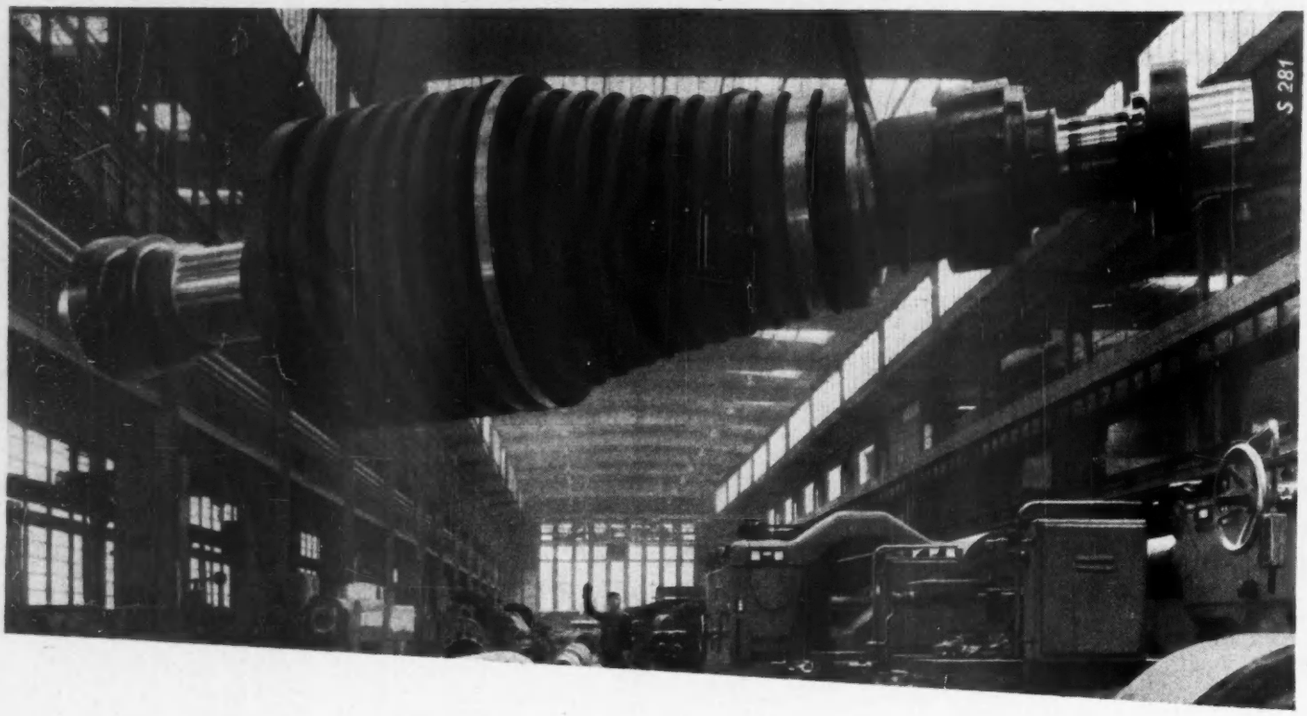
G. E. SIMM (MACHINERY), LIMITED,
27, Broomgrove Road, Sheffield, 10. E5517 G

FOR SALE

FRED WATKINS (ENGINEERING) LTD.

Fielding 800 ton Indenting Hydraulic Press, platens 5ft. 4in. by 4ft. 4in. and 5ft. 1½in. by 4ft. 1½in. with pump and motor.
Fielding 500-ton Vertical Downstroke Hydraulic Press. 42in. by 36in. platens, with pumps and motors.
Fielding 200-ton ditto, 3ft. stroke, with pumps and motors (5 available).
Fielding 100-ton ditto, 4ft. to 5ft. stroke, with pumps and motors.
Two 73ft. 4in. by 5ft. Kilns or Dryers, with Crofts Reduction Gear and 27 h.p. motor.
Two 26ft. by 4ft. Rotary Coolers or Dryers, with reduction gear and motor.
Available at low prices ex present sites to save cost of bringing into stock.

FRED WATKINS (ENGINEERING) LTD., COLEFORD, GLOS. E151 G



Our BV Vacuum Steel is specially suited
for Highly Stressed Machinery Parts

We produce such Forgings and Castings*

from our BV Vacuum Steel

*Steel forgings up to 150 tons ingot weight,
steel castings up to 400 tons cast weight
of carbon or alloy, open-hearth or electric steels

Bochumer Verein
für Gußstahlfabrikation AG. BOCHUM

Representatives for the U.K.:

THE STAHLUNION COMPANY LIMITED. 61 Pall Mall, London, S.W. 1, Telephone: Whitehall 5315 (7 lines)

INDEX TO ADVERTISERS

PAGE

AB Atlas/Copco, Sweden Cover ii
Abbott & Co. (Newark), Ltd. 103
Abingdon King Dick, Ltd. 90
Adamson, J., & Co., Ltd. 18
Air Control Installations, Ltd. 47
Airscrew Co. & Jicwood, Ltd. 130
Aiton & Co., Ltd. 116
Albright & Wilson (Mfg.), Ltd. 15
Allen, A., & Son, Ltd. 126
Allen, W. H., Sons & Co., Ltd. 76
Amal, Ltd. 71
Anderson, C. F., & Son, Ltd. 31
Arbuckle, Smith & Co., Ltd. 38
Arup & Arup, Ltd. 110
Ash, J., & Son, Ltd. 17
Ashmore, Benson, Pease & Co. 9
Auchterlonie, C., & Co., Ltd. 80
Austin, E., & Sons (London), Ltd. 71
Automation, Ltd. 77

B. A. Holland Engineering Co., Ltd. 17
BTR Industries, Ltd. 67
Bailey, Sir W. H., & Co., Ltd. 2
Baker, P. W., & Sons (Sales), Ltd. 107
Barnard & Sons, Ltd. 100
Barron, W. S., & Son, Ltd. 50
Beecham Buildings, Ltd. 79
Blackheath Stamping Co., Ltd. 92
Blackwell Bearings, Ltd. 78
Bochumer Verein 128
Booth, J., & Bros. 34
Boulton Paul Aircraft, Ltd. 38
British Aluminium Co., Ltd. 48
British Appliances Mfg. Co., Ltd. 115
British Electrical Development Association 23
British Ermeto Corporation, Ltd. 70
British Ropeway Engineering Co., Ltd. 14
British Siddeley Engines, Ltd. 57
British Steam Specialties, Ltd. 80
British Steel Piling Co., Ltd. Cover i
British Thomson Houston Co., Ltd. 82
Bronx Engineering Co., Ltd. 71
Broom & Wade, Ltd. 101
Brown, D., Corporation (Sales), Ltd. 33
Brown, N. C., Ltd. 37
Brownlie & Murray, Ltd. 62
Budenberg Gauge Co., Ltd. 46
Bullers, Ltd. 59
Bullows, A., & Sons., Ltd. 129
Burnett & Rolfe, Ltd. 60
Butcher, H., & Co. 127

C. & M. Engineering Co., Ltd. 89
Carter, B. & F., & Co., Ltd. 77
Clyde Crane & Booth, Ltd. 34
Clyde Crane & Engineering Co. 34
Cockburns, Ltd. 83
Cohen, G., Sons, & Co., Ltd. Cover iv
Colt Ventilation, Ltd. 3
Consolidated Pneumatic Tool Co., Ltd. 69
Cotton Bros. Longton, Ltd. 126
Cowlishaw, Walker & Co., Ltd. 103
Crane, Ltd. 37
Cranes (Dereham), Ltd. 81
Crockatt, W., & Sons, Ltd. 72
Crofts (Engineers), Ltd. 64
Cross Manufacturing Co. (1938), Ltd. 22
Cull, W. B., & Sons, Ltd. 72

Danks, E., & Co. (Oldbury), Ltd. 80
Davy-United 117
Dorman Long 44
Dowty Seals, Ltd. 29
Drummond - Asquith (Sales), Ltd. 28

Easton & Johnson, Ltd. 49
Edwards, L., & Co. (Engineers), Ltd. 103
Electrical Power Engineering Co. (B'ham), Ltd. 89
Electro-Dynamic Construction Co., Ltd. 49
Electropower Gears, Ltd. 14
English Steel Forge & Engineering Corporation, Ltd. 56
Entwisle & Gass, Ltd. 91
Evans, F. W., Ltd. 62

Farmer, L., & Sons. 127
Fawcett, Preston & Co., Ltd. 62
Ferranti, Ltd. 104
Fescol, Ltd. 11
Fielding & Platt, Ltd. 108
Filton, Ltd. 100
Firth Brown Tools, Ltd. 86
Firth, T., & Brown, J., Ltd. 66
Firth-Vickers Stainless Steels, Ltd. 39
Fleming & Ferguson, Ltd. 77
Flexible Ducting, Ltd. 91
Fluxite, Ltd. 95
Foord, J., & Co. 127
Fordsmith, H., Ltd. 35
Forster, T. S., & Sons, Ltd. 22
Fuller, Horsey, Sons & Cassell 127

Girdlestone Pumps, Ltd. 90
Godfrey, Sir G., & Partners (Industrial), Ltd. 99
Greening, N., & Sons, Ltd. 27
Griffiths, Gilbart, Lloyd & Co., Ltd. 72
Guest, Keen Iron & Steel Co., Ltd. 111
Gwynnes Pumps, Ltd. 94

Halesowen Steel Co., Ltd. 112
Hall & Hall, Ltd. 60
Harvey, G. A., & Co. (London), Ltd. 97
Hayward, E., & Co. (Fabrications), Ltd. 95
Herbert, A., Ltd. 50
Hermetic Rubber Co., Ltd. 14
Higgs Motors, Ltd. 13
Hill & Jackson (Springs), Ltd. 25
Hobson, H. M., Ltd. 87
Hoffmann Manufacturing Co., Ltd. Cover iii
Holmes, C. D., & Co., Ltd. 74
Holroyd, J., & Co., Ltd. 30
Holst & Co., Ltd. Cover iii
Hudswell, Clarke & Co., Ltd. 18
Hughes - Johnson Stampings, Ltd. 2
Hunt & Moscrop, Ltd. 59
Hyde, R., Castings. 99
Hydraulics & Pneumatics, Ltd. 7

Imperial Chemical Industries, Ltd. 51
Ince Forge Co. 27
International Combustion Products, Ltd. 106
Ironite Co., Ltd. 25

Jeavons, E. E., & Co., Ltd. 114
Jellyman, S., Ltd. 90
Jenkins, R., & Co., Ltd. 10
Jenks Bros., Ltd. 46

Kay & Co. (Engineers), Ltd. 16
Keith Blackman, Ltd. 113
Kempe's Engineers Year-Book 67
King, Geo. W., Ltd. 102

Lambhill Ironworks, Ltd. 52
Lanarkshire Bolt, Ltd. 78
Lancaster & Tonge, Ltd. 4
Lansing Bagnall, Ltd. 59
Leeds & Bradford Boiler Co., Ltd. 35
Lionweld, Ltd. 24
Lockheed Precision Products, Ltd. 55
London Electric Firm, Ltd. 69
Lynch, M., & Son, Ltd. 4

MacLellan, P. & W., Ltd. 4
Markland Scowcroft, Ltd. 36
Marshall Fleming & Co., Ltd. 103
Mason, E. N., & Sons, Ltd. 19
Mather & Platt, Ltd. 7
Mathison, J., Ltd. 96
Maxseal Valves, Ltd. 115
Metalastik, Ltd. 43
Metropolitan - Vickers Electrical Co., Ltd. 41
Micanite & Insulators Co., Ltd. 18
Mills, G. (Engineers), Ltd. 95
Mills, W., Ltd. 6
Mirrlees, Bickerton & Day, Ltd. 45
Mobil Oil Co., Ltd. 40
Mond Nickel Co., Ltd. 65
Morris, H., Ltd. 54
Moss Gear Co., Ltd. 111

National Steel Foundry (1914), Ltd. 24
Newalls Insulation Co., Ltd. 17
Newbury Diesel Co., Ltd. 89
Newton Sales Co., Ltd. 95
Nitralloy, Ltd. 71
Normand Electrical Co., Ltd. 100
Norris Brothers, Ltd. 27

Oberman, J. H., & Sons, Ltd. 110
Osborn, S., & Co., Ltd. 12

Parker, F., Ltd. 92
Parkinson, Sir Lindsay & Co., Ltd. 73
Patent Lightning Crusher Co., Ltd. 78
Phœnix-Rheinrohr A.G. 46
Pinchin, Johnson & Co. 109
Pioneer Oilsealing & Moulding Co., Ltd. 35
Pitman, Sir Isaac & Sons, Ltd. 121
Plenty & Son, Ltd. 5
Pool, J. & F., Ltd. 109
Potter, F. W., & Soar, Ltd. 77
Power-Gas Corporation, Ltd. 9
Precision Rubbers, Ltd. 36
Prodorite, Ltd. 31

Ratcliffe, F. S. (Rochdale), Ltd. 62
Rhodes, J., & Sons, Ltd. 16
Ross, R. G., & Son, Ltd. 105
Rotork Engineering Co., Ltd. 27
Round Oak Steel Works, Ltd. 88

Sadi Engineering Co., Ltd. 21
Saunders Valve Co., Ltd. 115
Savery, T., Pumps, Ltd. 111
Schieldrop & Co., Ltd. 22
Schmitt, Ed., & Cie, G.m.b.H. 79
Scriven Machine Tools, Ltd. 89
Semtex, Ltd. 26
Shaw, J., & Sons (Salford), Ltd. 110
Slingsby, W., & Co., Ltd. 80
Smedley Bros., Ltd. 89
Smith & McLean, Ltd. 61
Smiths Industrial Instrument Division 75
Spencer - Bonecourt - Clarkson, Ltd. 67-96
Spiral Tube & Components Co., Ltd. 115
Standard Piston Ring & Engineering Co., Ltd. 36
Steel Construction Co., Ltd. 60
Steels Engineering Products, Ltd. 84-85
Sterling-Safway 32
Strachan & Henshaw, Ltd. 63
Sturtevant Engineering Co., Ltd. 74
Suffolk Iron Foundry (1920), Ltd. 79
Sulzer Bros. (London), Ltd. 98

Taylor & Challen, Ltd. 21
Taylor, Taylor & Hobson, Ltd. 93
Technoexport 42
Telco, Ltd. 89
Thermal Elements. 61
Thornton, B., Ltd. 53
Tilghman's, Ltd. 105
Tonks, J., & Co., Ltd. 89
Tubeman Stainless, Ltd. 27
Turbine Furnace Co., Ltd. 109

Vacuum Industrial Applications, Ltd. 61
Vero, E. W., & Co., Ltd. 35
Vokes, Ltd. 118

Walker Bros., Ltd. 22
Waldenmaier, J. Erhard H. 25
Wallsend Slipway & Engineering Co., Ltd. 8
Ward, T. W., Ltd. 58-126
Weir, G. & J., Ltd. 20
Westwood Dawes & Co., Ltd. 109
Wheatley & Whiteley. 18
Wheatley Kirk, Price & Co. 127
Whitehouse, G. H., & Son, Ltd. 68
Wicksteed, C., & Co., Ltd. 112

TRIBUTE FROM ANTARCTICA . . .

T.A.E. Photograph

The Ross Sea Committee of the Trans-Antarctic Expedition has sent the photograph alongside and a report written by Mr. J. E. Hoffman, the drilling and explosives expert at Scott Base, of which the following is an extract —

"The Hydrovane '60' Compressor was used attached to one of the Ferguson tractors through the standard power take-off. A four inch flat belt was used for the main drive The main function of the compressor was to supply air to remove cuttings while drilling holes from five to twenty feet with a portable rotary diamond drill . . . . and in addition, air was used for conventional type percussion drills and spades.

The compressor was never a worry and always operated according to the maker's specifications. The average summer temperature in which they were used was between 15°F. and 20°F., and the only modification was a canvas cover to close off cooler during warm-up period. Oil recommended and supplied by B.P. was used throughout the 500 hours of operation and the compressor was in first-class order when the job was completed.

In conclusion, I can have nothing but praise for the Hydrovane '60' compressor and could recommend it for any future work under the very difficult conditions to which it was subjected."

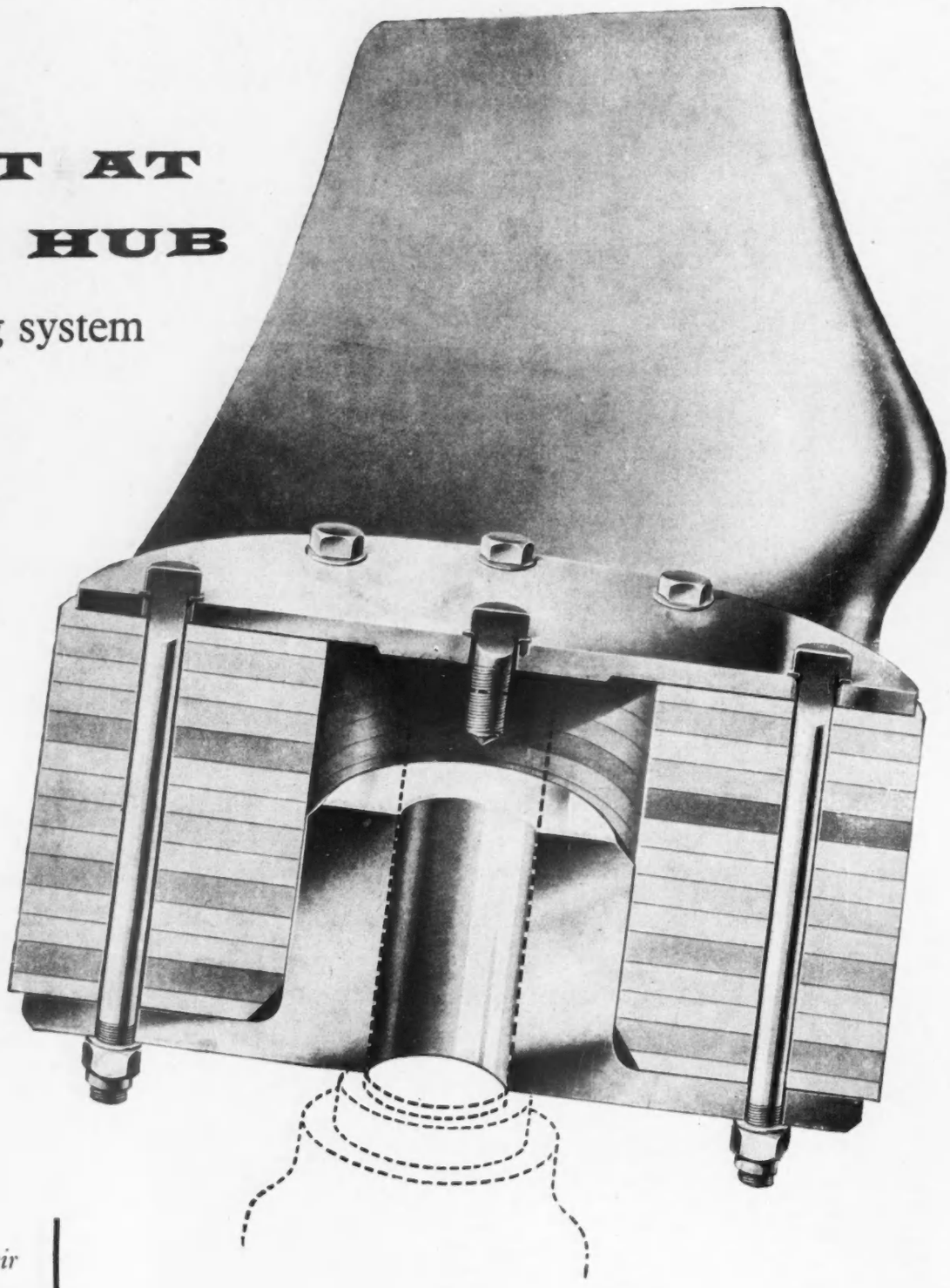
(Signed) J. E. Hoffman.

BULLOWS ALFRED BULLOWS & SONS LTD · LONG ST · WALSALL · STAFFS · TEL 5401

Makers of the original oil-sealed rotary compressors

RIGHT AT THE HUB

of a cooling system



Because of their exceptional long life and efficiency wooden fans have been found ideal for cooling tower work

Airscrew are the only manufacturers of 24-feet wooden cooling tower fans in Gt. Britain. We have been in the business for a long time, and our experience gives us a great understanding of cooling tower fan problems — problems we know how to answer.

AIRSCREW

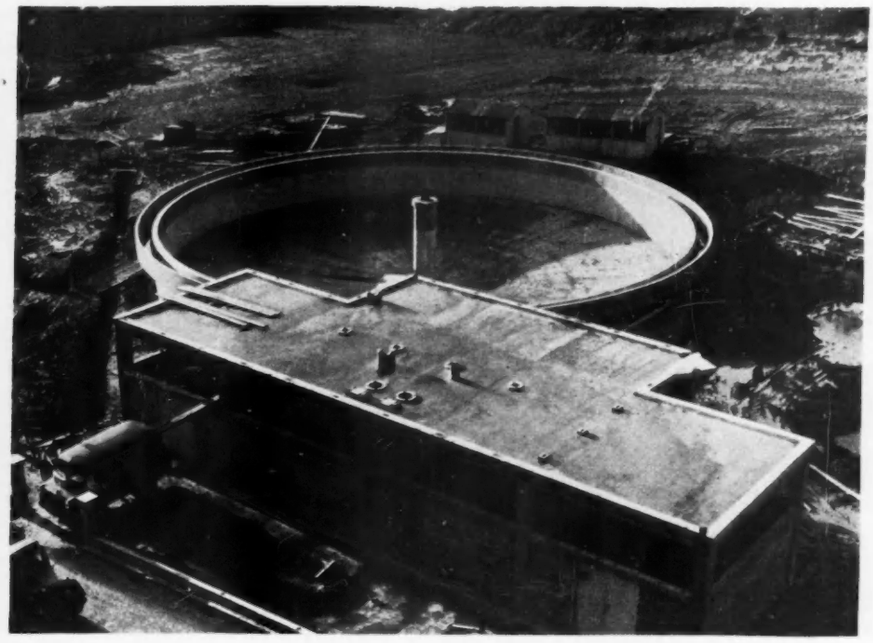
The ONLY British manufacturers of 24-ft. WOODEN COOLING TOWER FANS

THE AIRSCREW COMPANY & JICWOOD LIMITED · WEYBRIDGE · SURREY · *Telephone: Weybridge 2242/6*

WPS 68

PRINTED BY GEORGE REVEIRS, LTD., 10/12, ROSEBERY AVENUE, LONDON, E.C.1, FOR THE PROPRIETORS, MORGAN BROTHERS (PUBLISHERS), LTD., 28, ESSEX STREET, STRAND, LONDON, W.C.2. 7/11½

REINFORCED CONCRETE



FOR TANKS OR OTHER SIMILAR STRUCTURES

We undertake the complete work, including Design and Construction. At any of our Local Branches, you will find experienced Engineers ready to discuss your requirements.

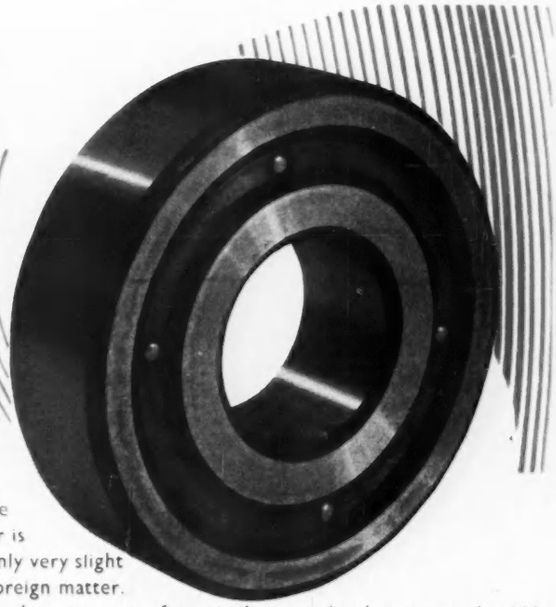
HOLST
& CO LTD
Civil Engineering Contractors, Reinforced Concrete

Head Office: 46 CLARENDON ROAD, WATFORD, HERTS.
Telephone: Watford 34481

BRANCHES: BIRMINGHAM · MANCHESTER · LEEDS · DURHAM · EDINBURGH · CARDIFF

WHAT A LIFE!

50



years of it, is the startling record of this Hoffmann Ball Bearing on a Royce crane. And after this marathon run, wear is imperceptible on the moving parts and only very slight damage to tracks due to the ingress of foreign matter.

If you have a Hoffmann Bearing which as been in service for a similar period or longer, we should be most interested to have details. The bearing would naturally be Hoffmann, as we were then the only British manufacturers of the radial ball bearing.

HOFFMANN **BALL & ROLLER BEARINGS**

BACKED BY 60 YEARS OF BEARING KNOWLEDGE AND EXPERIENCE

THE HOFFMANN MANUFACTURING CO. LTD., CHELMSFORD, ESSEX

Introducing THREE NEW 20-TON

Jones cranes

3 YEARS' GUARANTEE AND UNEQUALLED SERVICE

THE 600 GROUP OF COMPANIES

20 TON CAPACITY

All the advantages of modern design and manufacturing methods are incorporated in the new Jones KL 12-20 range of cranes. Diesel-powered, they are reliable, manoeuvrable, fast and economical. The proved Jones direct diesel/mechanical transmission gives full engine power to all motions and allows precision load control at all times. Write for illustrated literature and detailed specifications.

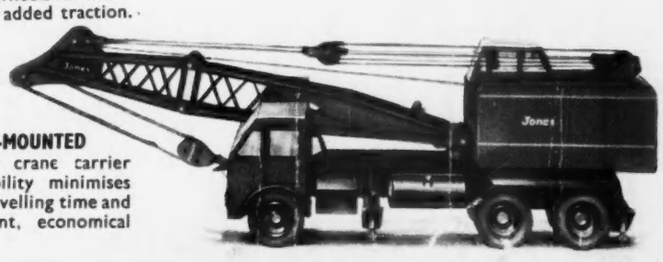
SECTIONAL LATTICE JIBS UP TO 100 FT. • CENTRALLY MOUNTED SUPERSTRUCTURES • HIGH OPERATING SPEEDS • FINGER TIP, POWER-ASSISTED CONTROLS • EXCELLENT VISIBILITY.

Jones cranes

take the load!

KL 12-20R RAIL-MOUNTED
A powerful, self-propelled rail crane. Lifts 20 tons and has an ample reserve of power for shunting.

KL 12-20M MOBILE
Exceptionally manoeuvrable, 2- or 4-wheel differential drive and JONES restrictor wheels for maximum stability and added traction.



KL 12-20L LORRY-MOUNTED
on a heavy duty crane carrier chassis, high mobility minimises non-productive travelling time and makes for efficient, economical handling.

Distributed in the United Kingdom by
GEORGE COHEN SONS & COMPANY LIMITED
Wood Lane, London, W.12

Designed, Manufactured and Exported by their Associates
K & L STEELFOUNDERS AND ENGINEERS LIMITED, Letchworth, Herts.